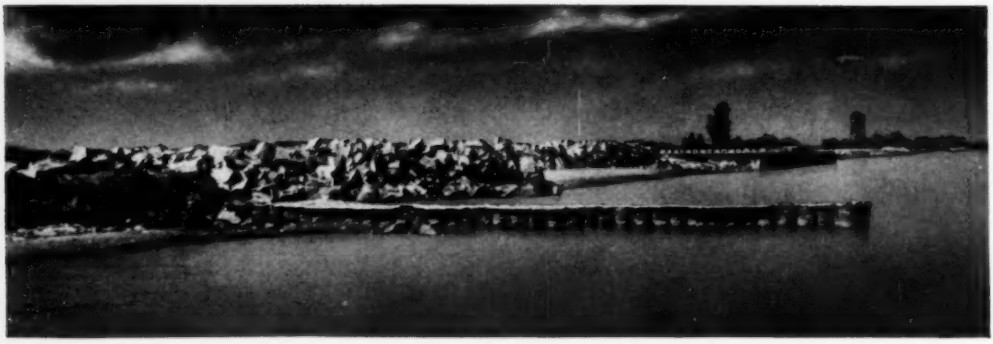
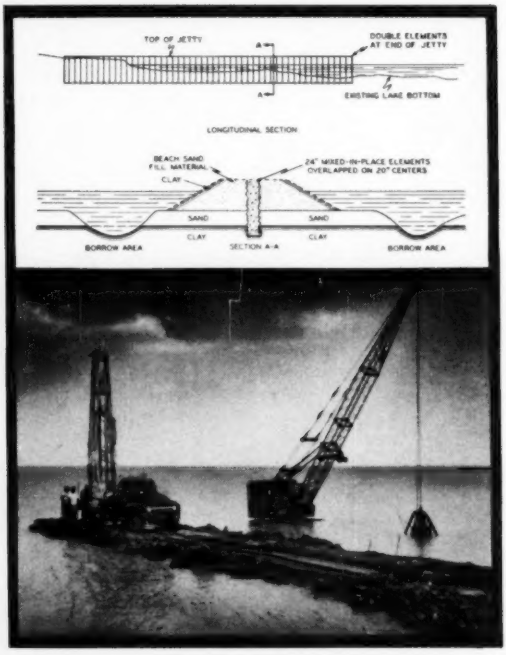
ACI News Letter

Vol. 25, No. 8 JOURNAL of the AMERICAN CONCRETE INSTITUTE April 1954



PREPAKT USES *MIXED-IN-PLACE* GROUT PILES AS...

New Way to Combat Shore Erosion



100-FOOT BEACH PROTECTION JETTY (photo—top of page) at Camp Perry, Ohio, consists of overlapping 24" **Mixed-in-Place Grout** piles 8 to 10 feet long (diagram). Rig (bottom photo), operating from roadway built by clam shell, injected Intrusion Grout into sand through hollow drill shaft. Piles set before clay and sand washed away.

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*Div. of Shore Erosion, Dept. of Natural Resources

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ACI

News Letter Contents

April 1954

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Keener Competition Between Building Materials Points to Importance of Technical Developments in Concrete Industry

ACI Golden Anniversary Convention spotlights latest developments in techniques, processes, and products

Appropriately, the American Concrete Institute celebrated its Golden Anniversary Convention by devoting a major share of the program to the latest technical developments, with just a brief glimpse at an enterprising past. Even this review of past developments was related to the future as evidence of a growing technology and things to come. Keener competition between building materials and continuing technical developments were shown to be closely related to the progress of the concrete industry in the big 1954 construction market.

Held at the Shirley-Savoy Hotel, Denver, Colo., February 22-26, ACI's 50th annual convention had an official registration of 786 from all parts of the United States, as well as Australia, Canada, Chile, England, Iran, Mexico, and Pakistan. In addition, a record registration of ladies was established, with 165 members' wives attending and enjoying the special program arranged for them. ACI last met in Denver in 1948.

A crowded technical program attracted large audiences. One full day was devoted to technical committee meetings, two days to technical sessions, another day to the annual research session, and a tour of the Bureau of Reclamation Laboratories, and the final day to inspection trips.

ACI technical committees presented two new standards for adoption, and the second ACI-PCA film, "How to Transport, Place, Finish, and Cure Quality Concrete," was previewed.

Continued on p. 4

Convention sessions covered a wide range of subjects, including a history of the Institute, economic trends affecting building markets, selection of construction materials, and use of concrete by the Bureau of Reclamation and Corps of Engineers. An evening session was devoted to motion pictures.

The design session included papers on blast design, long shell roofs, rigid frame bridges, dams, and flat slabs. The materials and construction session featured papers on a folded flat plate roof structure, structural applications of hyperbolic paraboloids, combined form and reinforcement for slabs, cellular concretes, and factors influencing strength of concrete.

The session on precast and prestressed concrete covered sandwich type construction, a precast concrete hangar, plant production of prestressed units, fatigue tests of partially prestressed concrete, and continuous prestressed members. Materials and properties were featured in another session, including admixtures, drying shrinkage of concrete block, air-entrained concrete, effect of age of concrete on its resistance to scaling, and estimating water content of concrete at time of hardening.

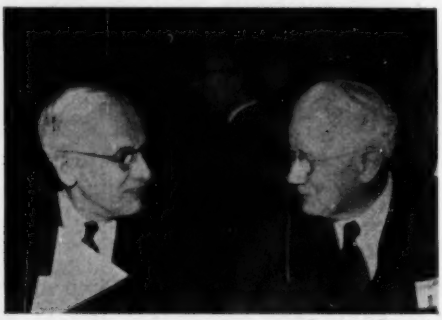
Social events included the Anniversary Dinner, Awards Luncheon, a dinner dance, and a buffalo barbecue luncheon. The convention also featured a special exhibition area with more than 35 exhibits arranged by manufacturers and engineering firms.

The majority of papers presented at the Denver meeting, some of which have already appeared in the ACI JOURNAL, will be published in later issues.

Technical committees discuss wide range of subjects

The first day of the convention was devoted to ACI technical committee meetings. More than 25 committees or subcommittees met to discuss a wide range of subjects, including design and construction problems, precast and prestressed concrete, ACI Building Code, aggregates, curing, residential concrete work, and others.

Committees that met during the Denver meeting were: Committee 115, Research; Committee 208, Bond Stress; Committee 209, Volume Changes and Plastic Flow in Concrete; Committee 212, Admixtures; Committee 213, Properties of Lightweight Aggregates and Lightweight Aggregate Concrete; Committee 214, Evaluation of Results of Compression Tests of Field Concrete; Committee 315, Detailing Reinforced Concrete Structures; Committee 323, Prestressed Reinforced Concrete; Committee 324, Precast Reinforced Concrete Structures; Committee 327, Ultimate Load Design; Committee 332, Recommended Practice for Residential Concrete Work; Committee 609, Compaction of Concrete by Mechanical Means; Committee 612, Recommended Practice for Curing Concrete; Committee 613, Recommended Practice for Proportioning Concrete Mixes; Committee 616, Recommended Practice for the Application of Paint to Concrete Surfaces; Committee 617, Specifications and Recommended Practice for Concrete Pavements and Bases; and Committee 716, High-Pressure Steam Curing.



Courtesy Concrete

ACI past presidents Frank H. Jackson, left, and Franklin R. McMillan review Institute experiences

Committee 318, Standard Building Code, had one full committee meeting, as well as meetings of the various subcommittees. Subcommittee sessions included those of Subcommittee 2 on materials and tests; Subcommittee 3 on concrete quality; Sub-

committee 6 on design (general considerations and flexure computations); Subcommittee 8 on shear and diagonal tension, bond and anchorage; Subcommittee 10 on flat slabs; and Subcommittee 11 on columns and walls.

All committee meetings were well attended as was evidenced by a registration of about 500 ACI Members the first day.

Two new standards presented

Two standards were presented by Institute technical committees at the opening general session Tuesday morning, February 23, presided over by ACI President Henry L. Kennedy. The two standards, which have now gone to letter ballot of the Institute membership, covered concrete chimneys and mix design. The second ACI-PCA film on concrete was previewed. The session also featured a review of the Institute's history.

Reinforced concrete chimneys

E. A. Dockstader, chairman, Committee 505, presented a proposed standard that gave criteria for the design of reinforced concrete chimneys and outlined construction procedures. Published in the January, 1953, JOURNAL, p. 353, and first presented at the 49th annual convention in Boston for discussion, "Proposed Standard Specifications for the Design and Construction of Reinforced Concrete Chimneys" was recommended for adoption as an Institute standard. Committee 505 offered as amendments certain revisions (*News Letter*, ACI JOURNAL, Mar. 1954, p. 7) which were accepted by convention vote. In addition to these changes, minor editorial revisions in the proposed standard were also acted on favorably.

The specification, replacing a tentative standard in effect since 1936, sets forth recommended loadings, including provision for both wind and earthquake, for the design of reinforced concrete chimneys. Methods are also recommended for determining the stresses in the concrete and reinforcement resulting from these loadings. The method of analysis includes determination of the stresses at horizontal cross sections where flue openings occur as well as at sections where the cross section is an annular ring.

Formulas are recommended for determining the temperature gradient through the concrete resulting from the difference in temperature of the gases inside the chimney and the surrounding atmosphere, together with methods for determining stresses in the concrete and reinforcement both vertically and circumferentially due to the temperature gradient through the concrete. Formulas for combining the stresses due to dead, wind, and earthquake loads with stresses due to temperature are included, as well as numerous charts to aid the designer.

The proposed standard has now gone to ACI membership for a secret letter ballot to be canvassed June 1.

Mix design

Committee 613's "Proposed Recommended Practice for Selecting Proportions for Concrete," presented by Walter H. Price, chairman, was also adopted with minor amendments, by convention vote. It has now gone to ACI membership for ratification by secret ballot to be canvassed June 1.

The standard will supersede ACI's 1944 standard, "Recommended Practice for the Design of Concrete Mixes (ACI 613-44)."

As published in the October, 1953, ACI JOURNAL, p. 105, the proposed standard sets forth recommended practice for the proportioning of concrete, including mixes containing entrained air. Tables are provided which, along with laboratory tests on physical properties of aggregate, yield information rapidly for obtaining concrete proportions. Examples illustrate the design of air-entrained and non-air-entrained mixes, and a simple method of obtaining mix proportions for the small job is included.

Quality concrete movie

The motion picture "How to Transport, Place, Finish, and Cure Quality Concrete" was a sequel to the film "Quality Concrete" produced last year by the Portland Cement

Assn. in cooperation with ACI. This second ACI-PCA film on proper techniques in handling concrete was introduced by Prof. James A. McCarthy, Notre Dame University, chairman of the ACI Film Advisory Committee which passed on the technical details of the film.

History of ACI

As part of the American Concrete Institute's 50th birthday celebration, a special highlight of the Tuesday morning program was the paper "History of the American Concrete Institute," by Raymond E. Davis, professor emeritus, University of California, Berkeley, Calif., and noted consulting engineer.

In introducing Professor Davis, President Kennedy said: "On this golden anniversary occasion it seems appropriate to look back over what ACI has accomplished in that half-century and perhaps gain some insight as to where the society is going. Who better to do that than a man who has contributed mightily to that history for over half the Institute's present lifetime? Who better than a past president who, in addition to his administrative contributions to ACI's operation, can claim a long list of technical papers and technical committee accomplishments?"

Professor Davis then presented highlights from ACI's past from that first informal meeting in 1904, held during the Engineering Congress of the Louisiana Purchase Exposition, which culminated in the first annual convention in 1905 and organization of the National Association of Cement Users, to the Institute of 1954 with its worldwide membership.

Speaking of the formation of ACI's predecessor, the National Association of Cement Users, in 1905, Professor Davis said: "Thus there came into being a virile society concerned with the variety of problems—research, development, design, construction—of a new and rapidly growing industry." It was not until 1913 that the name was changed to the American Concrete Institute.

Through his whole narrative it was made clear by Professor Davis that ACI is not an "ivory-tower" organization, but one composed of men and accomplishments—men who believe in the value and future of concrete as a building material, and many of whom have made lasting contributions to the Institute and the industry. He mentioned the work of John P. Given, Richard L. Humphrey, Henry C. Turner, Edward D. Boyer, C. A. P. Turner, Leonard C. Wason, Duff Abrams, A. N. Talbot, Arthur R. Lord, Sanford E. Thompson, Alfred E. Lindau, John E. Conzelman, H. F. Gonnerman, John J. Earley, W. Leslie Comyn, H. M. Westergaard, W. A. Slater, Maxwell M. Upson, F. E. Richart, R. B. Young, F. R. McMillan, S. C. Hollister, W. K. Hatt, Harvey Whipple, and many others.

It was also interesting to note that some of the problems evident in the early days of the Institute are still problems in 1954. It was also evident that solution of some early problems led to the discovery of new ones, that the process of changing techniques and conditions leading toward better utilization of concrete is never-ending.

He also described briefly early 1900 techniques and practices in precasting, tilt-up

From far and wide

While naturally the Denver area provided the largest group attending the 50th annual convention, 43 other states, District of Columbia, Australia, Chile, England, Iran, Mexico, and Pakistan were represented.

Colorado	290	Minnesota	4
Illinois	73	N. Carolina	4
California	47	Utah	4
New York	40	W. Virginia	4
Canada	29	Mexico	3
Ohio	29	Montana	3
Missouri	27	South Dakota	3
D. of C.	25	Virginia	3
Pennsylvania	22	Arizona	2
Texas	18	Australia	2
Wisconsin	16	Florida	2
Michigan	14	Louisiana	2
Iowa	13	Mississippi	2
Washington	13	S. Carolina	2
Massachusetts	9	Tennessee	2
Wyoming	9	Vermont	2
Idaho	8	Chile	1
Kansas	8	Connecticut	1
Nebraska	8	England	1
New Jersey	8	Georgia	1
Oregon	7	Iran	1
Oklahoma	6	Kentucky	1
Indiana	5	Maine	1
New Mexico	5	N. Dakota	1
Maryland	4	Pakistan	1

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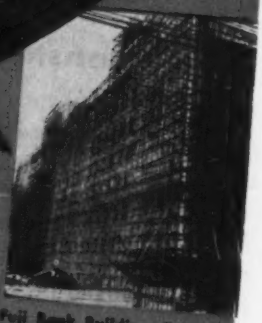

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construction, prestressing, and other phases which were indications even then of things to come in the 1950's. Many of the elements of modern construction were used successfully in those early days.

Professor Davis in concluding his discussion of the role which the Institute has played in bringing concrete to its present stage of development said: "Coming now to the closing years of the first half-century of the Institute, one is impressed by the fact that while its work is still concerned with many of the problems of the earlier years, such as aggregates and cements, concrete mix design, curing, strength, and durability, the scope of its activities has become greatly broadened."

"After five decades....," said Professor Davis, "the Institute has reached a degree of maturity—as judged by the quality and character of its work and by the diversity of its contributions to technical and scientific knowledge in the field of concrete." At the same time, there was the implied warning that the Institute cannot afford to become complacent, but must continually look to the future.

Big construction market predicted for 1954

In commemoration of ACI's 50 years of service to the concrete industry, one session on Tuesday, February 23, was devoted to appraising the concrete industry—past, present, and future. Session chairman was Henry L. Kennedy.

The 1954 construction market was viewed optimistically by Norman P. Mason, chairman, Construction and Civic Development Department Committee, Chamber of Commerce of the United States. (See p. 625 of this issue for a complete report.)

Based upon an assumption that the country's general economy will closely approximate last year's volume, with a possible drop of not more than 7 or 8 percent, Mr. Mason predicted that the construction industry will come close to the $34,720,000,000 goal achieved in 1953. He said that current predictions are that total new construction in 1954 will be about $34 billion, with two-thirds of this being private construction and one-third public.

While new housing construction may be down, it is expected that alterations and repairs will increase; while industrial construction may be down, commercial construction will increase; and while farm construction will be down, public utility construction will increase.

In the public construction field, Mr. Mason felt that highway construction and building of sewer and water facilities would increase. Construction of educational institutions will also be larger. Most other public construction will be down, he predicted.

Norman P. Mason

In looking forward to a busy year for the concrete industry, Mr. Mason noted that there is nothing finished nor static about the industry and that its possibilities for growth were tremendous. He then outlined five basic factors which would affect the concrete industry, as well as the whole construction field, during the coming year.

He was of the opinion that the government would provide a climate favorable to construction, both taxwise and through other encouragement.

Financing will be readily available in all lines, he felt, and there is every indication that it will continue to be so. Only in the field of highway construction is it likely that the availability of financing may be a controlling factor.

The desire of the public for highways, schools, stores, and many other facilities is unsatisfied. The demand for new construction will continue high, said Mr. Mason. He mentioned the tremendous public re-

lations task facing the industry in keeping the public informed on methods, problems, and costs of the building field.

Competitive products will keep the various sections of the building industry on their toes, he said. He felt that the concrete industry will need to work hard to hold some of its markets, but the need of meeting this competitive market will serve to strengthen the industry. How aggressive the sales policy is, how good research is—these are essential factors in meeting competing products, Mr. Mason pointed out. The public will base its choice of type of building upon such factors as style, cost, durability, and appearance. The concrete industry has to meet competing materials on this basis, he emphasized.

The fifth basic factor mentioned by Mr. Mason was that of research and development. New methods and better results are the things which will hold markets and create new ones. The concrete industry has already developed precast concrete decking and joists, prestressed concrete, tilt-up and lift-slab construction, and air-entrained concrete. There is never an end to this development; there is always the search for lower cost methods of developing better construction, concluded Mr. Mason.

Selection of materials

Rear Admiral J. F. Jelley, (CEC) USN, Director of Construction, Department of Defense, and formerly head of the Bureau of Yards and Docks, took a more detailed look at one phase of building in "Selection of Construction Materials." (See p. 633 of this issue for the complete report.) Keener competition between various construction materials is to be expected, he said, making proper selection of materials essential. One of the most important responsibilities of the engineer, he emphasized, is the selection of the most economical, the most efficient, and the most suitable material of construction.

In the postwar period, Admiral Jelley pointed out, the building industry has made noteworthy progress. Both the quality of materials and their methods of utilization have been improved. New techniques have been developed to increase the range and efficiency of applications. In the field of concrete, the techniques of precasting and prestressing have created new fabrication tools whose tremendous potentials are yet to be realized. These tools, powerful as they are, will remain unused unless they can be put to profitable use, said Admiral Jelley.

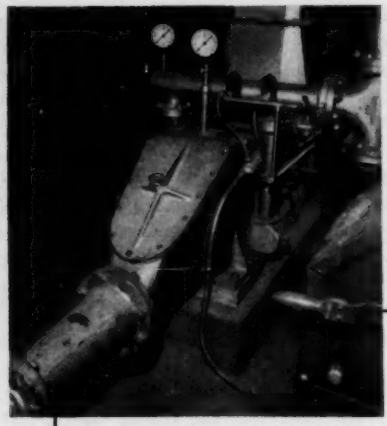
A good share of the needed incentive, he emphasized, will come from the tighter market of competing materials. Admiral Jelley felt that this competition was a guarantee that the quality and more advantageous uses of concrete would continue to grow.

Selection of the proper materials is complex, he noted. The first cost is not the only factor to be considered, he pointed out. The total cost over the life of the facility must be determined. This requires that the cost of maintenance and upkeep and any operational cost be taken into account. For a structure with a long life, he said, maintenance expenditures may amount to more than the initial cost.

Concrete is often sold on the basis of low upkeep and long life, but only by adequate cost data can it be proved in a competitive market that concrete will save money over the life of the facility, Admiral Jelley warned.

Admiral Jelley concluded that to insure concrete quality, engineers, contractors, ready-mixed concrete operators, aggregate and cement producers, and interested unions can do a great deal by perfecting their part of the process. Only through good construction practices can the building industry obtain the fullest benefit from the research

Three of the speakers from the special general session gather to talk it over. Left to right are Rear Admiral Joseph F. Jelley, CEC, USN, Director of Construction, Department of Defense; W. A. Dexheimer, Commissioner of Reclamation, U. S. Department of the Interior; and Major General Samuel D. Sturgis, Jr., Chief of Engineers, Department of the Army



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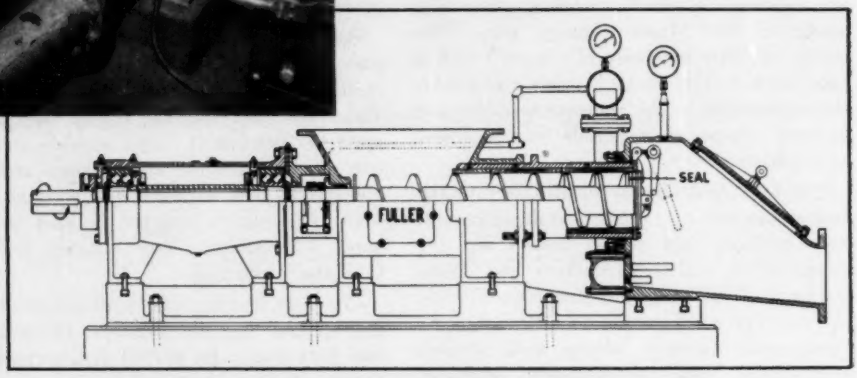

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USBR use of concrete

"Concrete in Reclamation Construction" described use of concrete by one of the largest construction agencies of the United States, the U. S. Bureau of Reclamation. W. A. Dexheimer, Commissioner of Reclamation, U. S. Department of the Interior, noted that although outstanding advances have been made in concrete technology during recent years, there are still many opportunities remaining for improvement. (See p. 637 of this issue for the complete address.)

"Objectionable cracks still appear in our structures. There are a few unexplained instances of rapid deterioration. The resistance of concrete to abrasion, chemical attack, and frost action might be improved. Frequently false or premature set hampers placing operations. Our construction methods might be improved to reduce cost and improve quality," he reminded the audience.

"We must design more exactly, appraise margins of safety more accurately, and improve qualities of control," emphasized Mr. Dexheimer. All these things, he pointed out, represent a challenge to the American Concrete Institute and the industry. For every bit of knowledge we possess today about the use and behavior of concrete there is at least as much more to learn, he said.

As the Bureau of Reclamation's principal construction material, concrete of good quality is of more than academic concern to the Bureau, said Mr. Dexheimer. The Bureau has placed, on the average, more than 2,000,000 cu yd of concrete for each of the last 20 years.

Although the Bureau is most noted for its major concrete dams, it also builds hundreds of smaller structures of reinforced concrete. The search for greater safety and economy in the design of these structures keeps the Bureau vitally interested in technical progress and developments through which these goals may be achieved, he said.

In speaking of inspection practices, Mr. Dexheimer noted that the Bureau believes in constructing by contract, entered into through competitive bidding, thereby gaining the benefits of the private enterprise and initiative of the contracting industry. Under a competitive bidding system, where there is a variation in experience and competency among contractors, he pointed out the desirability of detailed and insistent inspection to assure first-class work.

Mr. Dexheimer also described some of the work by the Bureau's laboratories in helping to develop new techniques and basic concepts in the art of concrete construction. Information obtained through laboratory research on cement and concrete has saved many times its cost, he said. It has resulted in better and longer lasting structures and in contributions to general engineering knowledge.

Corps of Engineers use of concrete

Major General S. D. Sturgis, Jr., Chief of Engineers, U. S. Army, closed the session by reviewing "Use of Concrete by the Corps of Engineers." (See p. 645 of this issue for the complete address.) The Corps is placing a lot of concrete, both at home and abroad, and likely to continue to do so, he predicted. The civil works program totals about $525,000,000 this fiscal year; a military construction program, world-wide in scope, totals more than $4½ billion.

Concrete plays a vital part in the Corps' ability to provide the bases, structures, and facilities of this investment, said General Sturgis. Concrete has been a major factor in enabling the Corps of Engineers to push into inhospitable corners of the earth where potential aggregates in the form of sand, gravel, or rock were practically the only available resource, he pointed out.

The whole field of airfield runway construction has changed since World War II, he said, with major import to the concrete industry. Modern military aircraft require the best and most durable runway construction modern technology and materials can make possible, he said. At present, about 44 percent of the pavement built by the Corps, in terms of square yards, is rigid (concrete).

General Sturgis also said that so-called "temporary" barracks which have traditionally been built of lumber, are now often built of concrete or concrete block. A new military building that will cover about a fourth as much area as the Pentagon is being constructed of concrete panels. At Goose Bay,

Labrador, the Corps is completing 500,000 sq ft of warehousing by the tilt-up method, at a reduction in cost of at least one-third over originally planned standard construction. The Corps has also tried out various types of precast structural elements and used these sussessfully in Europe and Tripoli.

As a partial indication of the importance of concrete in the Corps of Engineers' civil works program, General Sturgis mentioned that more than 25,000,000 cu yd of air-entrained concrete have been placed by the Corps in major civil works structures since 1944.

While what may be called "pure" concrete research is not one of the Corps of Engineers' primary functions, General Sturgis said that the Corps had done considerable research on various phases while still relying largely on the initiative of industry and the driving power of competition to focus attention on and evaluate developments that can be used by the Corps. The Corps' laboratories have studied not only concrete materials and concrete *per se*, but also procedures and plants, and equipment.

In closing, General Sturgis said that during the past 125 years of unparalleled national expansion, and the construction that went with it, concrete has been the prime foundation upon which the "hard core" of public works has been and no doubt will always be built.

Motion pictures shown at evening session

Again this year an evening session, Tuesday, February 23, was devoted to motion pictures on concrete construction and related topics.

"Inside Story of Concrete" described concrete research conducted by the Corps of Engineers at the Waterways Experiment Station, Vicksburg, Miss., and at various test plots, as well as some of the recent developments in construction practices. Precast construction was illustrated in the Portland Cement Assn. film "Navy Builds All Precast Concrete Warehouses," which showed structures erected at the Great Lakes Naval Training Station by Corbetta Construction Co., Inc.

Precast construction was also featured in "Namao," shown through the courtesy of Safir Engineering Consultants Ltd., Vancouver, B. C., Canada, which described construction of a warehouse in Canada. The building, a single-story structure, was approximately 1500 x 500 ft. The roof structure consisted of precast elements carried on cast-in-place columns with 20-ft cross heads and on cast-in-place external walls. The column spacing was 40 ft in both directions and main beams were avoided with this type of construction.

"Prestressed Concrete Cylinder Piling Being Used for Off-Shore Work in the Gulf Coast Region," by Raymond Concrete Pile Co., described manufacturing and use of this type of piling. The final showing of the evening was "How to Transport, Place, Finish, and Cure Quality Concrete." This second ACI-PCA film on proper techniques in handling concrete is a sequel to "Quality Concrete" produced last year; this new film was also previewed at the morning session.

Left: P. W. Abeles (left), consulting engineer, London, England, is interviewed by Dale Morgan of radio station KFEL in Denver. Center: Clifford E. Pehl (left), Bechtel International Corp., New York, N. Y., discusses a problem with Raymond E. Davis, consulting engineer and professor emeritus, University of California, Berkeley. Right: R. F. Blanks (right), vice-president and general manager, Great Western Aggregates, Inc., Denver, and chairman of the ACI Denver convention committee, is interviewed for the radio audience

Concrete slabs use forms for reinforcement

One-way concrete slab construction in which high strength, galvanized corrugated steel is used for both forms and reinforcement was described by Bengt F. Friberg, consulting engineer, St. Louis, Mo., in "Combined Form and Reinforcement for Concrete Slabs," at the morning materials and construction session, Wednesday, February 24, under the chairmanship of Charles H. Scholer, which was held concurrently with the session on design. Mr. Friberg emphasized that wood forming is a major part of the cost of concrete slab construction and may be eliminated, mostly, through use of corrugated steel forms that remain in place and serve as reinforcement in the slab, and possibly, also as the ceiling surface. To allow for shear transfer, temperature steel is welded to the corrugated steel thus performing a dual function, said Mr. Friberg.

Concrete slabs formed using this construction method, which Mr. Friberg called the "re-form" system, have been used to some extent during the last 50 years, mostly for short spans and light construction. Generally the re-form was supported only at its end for construction loads as well as for the completed slab. Flexural reserve strength is substantial in such floors, but, it must be considered, pointed out Mr. Friberg, that construction loads are often as severe, in concentration, if not distribution, as the floor live loads and reinforced concrete concepts do not apply during construction. Re-forms serving in flexure during construction, therefore, would weigh as much as a steel floor for the same span. However, it was explained that this might be overcome by dividing normal slab spans into two or three shorter construction spans by using temporary supports to be removed as the concrete develops its strength.

This and other problems involved in using the re-form method were detailed by Mr. Friberg before other features and applications for re-form construction were discussed.

By materially decreasing time and labor in the costliest operation of concrete slab construction, forming, re-form construction may be expected to extend the economic use of one-way concrete slabs, explained Mr. Friberg. As with other new construction methods, considerable variation exists in construction costs, depending upon varying familiarity and experience of the construction trades. Generally, re-form placement has been assigned to the reinforcement crews, temporary supports to the form trade. Spans longer than 14 ft await the commercial availability of re-form of longer length.

Re-form has received its greatest use in tall-building construction, he said, with spans generally from 8 to 11 ft. The re-form has been placed in close coordination with the structural steel to serve as an immediate safety deck under steel erection operations. Light trade, negative bar, and utility installations have generally been made without temporary supports, placed shortly ahead of concrete operations.

For commercial and industrial applications, exposed construction has generally been sufficient both in appearance and fire resistance, and smooth light ceilings have special advantages in some installations, noted Mr. Friberg.

Strength of concrete

The morning program also included an investigation of "Factors Influencing the Strength of Concrete as Revealed by a Six-Year Record of Concrete Control," by J. J. Waddell, materials engineer, Palmer and Baker, Inc., New Orleans, La. (See Dec. 1953 JOURNAL, p. 285, for complete report.) A summary of six years of concrete control data for the Friant Kern canal and distribution systems for the Bureau of Reclamation's Central Valley Project in California, during the period June, 1946, to June, 1952, revealed several relationships, plotted between the different qualities of the concrete, which disclosed both an over-all trend and a cyclic variation.

Careful attention to all steps of concrete production was part of the inspection and engineering control in the construction of the Friant Kern canal and distributing systems. Tests were made regularly on the concrete and its constituents which enabled certain conclusions to be drawn, disclosed Mr. Waddell.

These, he concluded, showed that an absolute correlation of the variations of the properties of the concrete under study cannot be achieved. Moreover, some of the variations in water requirement are not clearly understood or explained. It is entirely possible, he said, that in addition to the factors included in this analysis certain other variants of concrete control influenced the water requirement and the strength characteristics of the concrete. The water requirement is not an ultimate cause; it is an immediate cause and is itself the result of certain basic causes, some of which are obscure. The basic causes, Mr. Waddell believed, appear to be the changes in sources of materials, methods of handling materials, and cyclic weather variations.

Cellular concretes

Rudolph C. Valore, Jr., National Bureau of Standards, Washington, D. C., reviewed the methods of preparing and the physical properties of moist- and high-pressure steam-cured cellular concretes, ranging in density from 10 to 100 lb per cu ft, as they have evolved in Europe in the past 30 years. He also presented data on experimental mixtures prepared at the National Bureau of Standards.

He believed that cellular concretes, particularly those cured in high-pressure steam, offer intriguing possibilities for the concrete industry. At the same density the autoclaved lightweight materials are of greater strength and dimensional stability, but also of higher absorption, he said, than moist-cured lightweight aggregate concretes. He noted that a combined cellular-lightweight aggregate autoclaved material might offer an ideal compromise of the physical and economic factors. However, considerable research is desirable on many unexplored phases of the problem of cellular concretes.

He described the various processes: preformed foaming, aluminum powder and hydrogen peroxide gas-forming processes, and the excess water process. The most economical and controllable cell-forming process he believed was the preformed foaming, which employs hydrolyzed protein foaming agents.

The moist-cured materials described contained portland cement, neat or with sand. Cellular neat cement had adequate strength for structural use at densities above 40 lb per cu ft, but the linear drying shrinkage ranged from 0.3 to 0.6 percent. Cement-sand mixtures had lower strength, higher shrinkage, and higher absorption than lightweight aggregate concretes of comparable density.

The autoclaved materials described contained portland cement or lime and finely

ACI Members found much of interest in the tour through the U. S. Bureau of Reclamation Laboratories. Left: Manuel Donde Gorozpe (left), chief, Cement and Concrete Laboratories, Mexican Hydraulics Resources Ministry, Mexico City, Mexico, and Felix Candela, architect in Mexico City, pose before the Bureau's 5,000,000-lb testing machine. Center: M. A. Swayze (left), director of research, Lone Star Cement Corp., New York City, and A. G. Timms, senior materials engineer, Bureau of Public Roads, Washington, D. C., inspect aggregate samples. Right: Display of test equipment attracts the attention of (l. to r.) M. B. Pierce, chief bridge engineer, Saskatchewan Department of Highways, Regina, Sask., Canada; Douglas E. Parsons, chief, Building Technology Division, National Bureau of Standards, Washington, D. C.; and J. W. Kelly, professor of civil engineering, University of California, Berkeley

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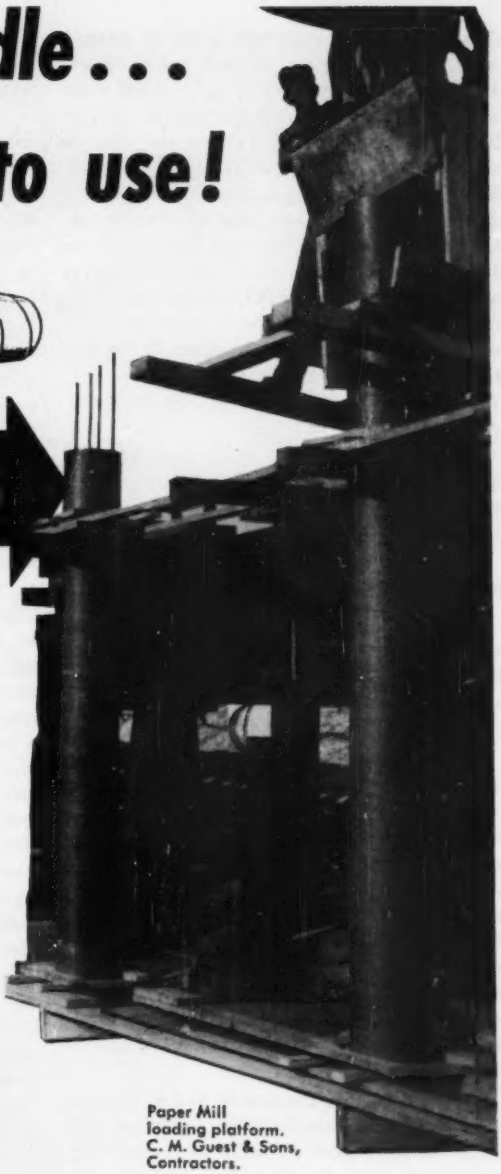

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divided siliceous materials such as ground sand, fly ash, burned oil shale, and others. Ratios of binder to "pozzolan" ranged from 1:0.5 to 1:4 for cement and 1:1 to 1:6 for lime, depending on the fineness and composition of the binder and siliceous material. Elasticity, thermal expansion, fire resistance, and acoustic properties were also discussed. Compressive strengths cited were 250 to 1000 psi at 30 lb per cu ft, 400 to 1000 psi at 40 lb per cu ft, and 800 to 3000 psi at 50 lb per cu ft. Flexural strengths were 1/5 to 1/3 of the compressive strengths. Drying shrinkages ranged from 0.01 to 0.10 percent. Water absorptions were 20 to 50 percent, by volume.

Mr. Valore reported that thermal conductivity was a function of density from 10 to 70 lb per cu ft, regardless of composition, cell-forming process, or curing.

Hyperbolic paraboloidical shells

An interesting type of roof construction was reported in "Structural Applications of Hyperbolic Paraboloids," by Felix Candela, architect, Mexico City, Mexico, and numerous slides illustrated various structures.

Hyperbolic paraboloidical surfaces are interesting from a structural and construction point of view. Their use in reinforced concrete shell roofs, Mr. Candela explained, offers the same advantages inherent to all shells of this material, *i.e.*, lightness, incombustibility, economy of material, security against explosions, bombardments and earthquakes, and little sensitiveness to foundation settlement. These last properties are consequences of their structural action, not restricted to one plane but working as space-frames, he said.

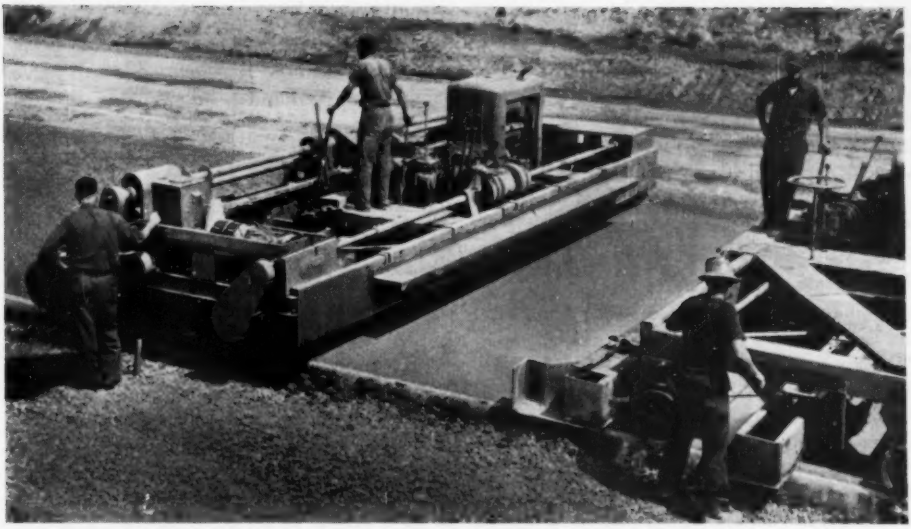
To support this statement which, due to a common confusion between lightness and frailty, is sometimes contrary to the general opinion, Mr. Candela said, it is pertinent to recall some known facts and examples.

Many shell structures in Germany showed remarkable resistance to bombing during the last war. In some important plants, he said, the damaged parts of the structure were cut away and rebuilt repeatedly after successive damage; total collapse was almost impossible in these structures.

Torroja's well-known shell roof of the Fronton Recoletos in Madrid, Spain, a double barrel vault of the so-called "gull wing" type, covering an unobstructed area of 180 x 110 ft, was severely damaged by bombing during the Spanish civil war. One of the many impacts (there were 17 in all) produced a hole in the roof of about 200 sq ft. In spite of deformations caused by the blast, he noted, the roof held up for several months before collapsing.

Equations of membrane stresses are especially suitable in describing stress conditions of doubly curved surfaces, explained Mr. Candela, since flexural stresses are only possible after extensional deformations of considerable magnitude. As an example he considered a revolution dome loaded symmetrically with respect to the rotation axis. Substantial extensional strains or variations of length of the parallel circles must necessarily occur before changes of curvature and consequent bending may appear along the meridian lines. Similarly, he noted, for a concentrated load, acting at any given point of a spherical dome, to produce dents in the shell surface, the circles must elongate materially around the considered point, a condition easily attainable in a rubber ball built of extensible material, but virtually impossible in a concrete dome until the direct stresses along the immediate circles have attained the huge values corresponding to the aforementioned strains. In the case of anticlastic shells, Mr. Candela noted, the intuitive analysis is not so easily visualized as in the dome, but the same principles—well known to the builders of car bodies—are involved. Consequently, bending stresses may only be expected in some particular cases and they are always limited to small zones in the vicinity of supports. Furthermore, he said, as they are skewed or nondevelopable surfaces, they have extraordinary resistance to buckling. Both characteristics allow the reduction of the shell thickness to a practical minimum and in many cases the elimination of stiffening ribs.

On the contrary, he went on, bending stresses and buckling danger are usually important in developable surfaces—especially in long cylindrical shells—where they condition dimensioning and design, requiring a substantial shell thickness.



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One last property, he noted, makes these shapes preferable to other curved surfaces in construction. They are generated by two systems of straight generatrix, which allows the formwork to be composed only of straight timber, without recurring to cumbersome and costly arched forms.

Frank Kerekes, assistant dean of engineering, Iowa State College, Ames, Iowa, aided in presentation of the paper.

Folded plate roof structure

Rounding off the Wednesday morning materials and construction session was "Design and Construction of a Folded Plate Roof Structure," by Milo S. Ketchum, Ketchum and Konkel, Consulting Engineers, Denver, Colo. The building under construction at this time for the H. W. Moore Equipment Co. in Denver, utilizes two types of folded plate shells; a discontinuous Z-shape shell arranged to provide a northlight clerestory and a continuous series of inverted V-shapes. The latter shell, he said, carries two 15-ton cranes on the roof system. Roof plates are being constructed with movable forms and certain elements are precast.

In selecting the type of structure, Mr. Ketchum explained, it was possible to consider long span reinforced concrete construction because of the decrease in insurance rates with fireproof construction. The site is outside the city limits of Denver which increases the insurance rate and the shop building will house large pieces of expensive equipment containing inflammable liquids.

The shop area requires heavy bridge cranes which would have a span of 80 ft unless they were carried by the roof framing. Therefore, he said, a reinforced concrete folded plate system was selected because it is possible to carry concentrated loads directly on the shell. In the office and display area it was possible to make use of this advantage by carrying a mezzanine suspended from the roof.

On the basis of these considerations, noted Mr. Ketchum, framing for the roof over the shop is a series of inverted V-shaped folded plates of 80-ft span and 36 ft width from ridge to ridge. The height above the floor is 20 ft except at a high crane bay where it is 26 ft. The thickness of the plates is 6 in. except at the supports where they are increased slightly for shear. The roof of the parts area and office area, he explained, is covered by another folded plate roof of Z-shape with a 75-ft span and 22-ft cantilever overhangs on each end. These shells are arranged so that a north light clerestory is provided between the roof units. The thickness of the plates is 4 in. and they are stiffened by concrete end walls and columns.

More rational design of concrete arch and gravity dams

The design session, under the chairmanship of Charles S. Whitney, Wednesday morning, February 24, was held concurrently with the materials and construction session and featured papers on concrete dams, design of long shell roofs, model analysis of a skewed rigid frame bridge and slab, flat slab analysis by models, and movies on the effects of atom blast.

Concrete gravity and arch dams

It is necessary at times to examine the fundamentals of concrete dam design to assure that design practices remain consistent with the existing knowledge and concepts and to put into practice accumulated knowledge as to the behavior of these dams during and after construction. Considerable applicable data have been gathered during the last few years, and with the large rise in construction cost, it was thought current practices might be revised to permit more rational design with attendant economy. With this in mind, a committee of 11 top members of the Bureau of Reclamation's design and construction force restudied the procedures and criteria used in designing concrete gravity and arch dams, said J. J. Hammond, chief, Dams Branch, U. S. Bureau of Reclamation, Denver, Colo., in

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his paper, "Basic Design Criteria for Concrete Gravity and Arch Dams." (See p. 657 of this issue for a complete report.)

Mr. Hammond then went on to treat in some detail basic design considerations, factors related to stability and instability, forces inducing stability, and design of concrete dams.

Flat slab analyzed by the Presan method

A report on the behavior of a square bay, flat plate, using the Presan method of model analysis, was presented by Gerald Bowen and R. F. Shaffer, Presan Corp., Los Angeles, Calif., in "Flat Slab Solved by Model Analysis." They showed the resulting quantitative and qualitative patterns, obtained over the entire bay, for bending moments, shears, and torsions, in the conventional x and y directions and in the principal directions, and for the elastic surface.

The authors explained the Presan procedure which requires a model in which the area to be analyzed is a polished, mirrorized plane. The model itself is so designed and constructed that it behaves elastically the same as the prototype structure, *i. e.*, the similitude equations between model and prototype are satisfied. If the mirrorized surface is placed so that it will reflect a grid of lines toward a camera, they said, the camera will, assuming the surface to be optically flat, record a scale reproduction of the grid. When the model is subjected to loads the mirrorized surface will become curved, and the camera will record a distorted image of the grid. By simple optics it may be shown, the authors noted, that the ratio of the undistorted to the distorted grid space at any point is a quantitative measure of the curvature at that point. If the distance between successive pairs of distorted lines is measured normal to the direction of the undistorted grid, a diagram of curvatures may be constructed. By constructing a series of such diagrams across the structure at frequent intervals, they explained, a surface of curvatures for one given direction is defined. By rotating the grid relative to the model, a surface of curvatures in any direction may be established.

Design of long shell roofs

George C. Ernst, R. R. Marlette, and Glen V. Berg, University of Nebraska, Lincoln, Neb., reviewed "Inelastic Analysis and Ultimate Load Design of Reinforced Concrete Cylindrical Long Shell Roofs," and emphasized that their methods do not replace elastic methods of analysis but do offer certain advantageous simplifications.

In extending the work of others to a design status, they found it necessary to treat the following factors, in addition to those in published reference material, (a) diagonal, or principal, tension stresses resulting from tangential shear, (b) thrust caused by the horizontal components of the difference in tangential shear, and (c) inelastic buckling under longitudinal thrust, and combined transverse thrust and moment at the crown. The analysis presented was limited to simply supported, long thin shells, although it was stated that the basic principles may be combined with a consideration of elastic deflections to simplify design of multiple unit and short shell roofs.

Structural action, inelastic buckling, ultimate load equations, and controlled tests were described, by the authors, before it was concluded that the structural behavior of

Courtesy U. S. Bureau of Reclamation

Inspecting a full-scale prestressed railroad bridge slab tested to failure at the Bureau of Reclamation Laboratories are (l. to r.) I. L. Tyler, manager, Field Research, Portland Cement Assn., Chicago, Ill.; W. C. Hansen, manager, Research Laboratories, Universal Atlas Cement Co., Gary, Ind.; L. H. Tuthill, concrete engineer, Bureau of Reclamation, Denver; and H. S. Meissner, research engineer, USBR

thin shell roofs at ultimate load may be divided into longitudinal bending of the shell as a beam of curved cross section and longitudinal bending as a slab. Factors to be observed in design, they said, include: longitudinal beam bending, with resulting flexural and diagonal tension stresses, and transverse moment and thrust; longitudinal slab bending, with regard to continuity at end stiffener or diaphragm; and inelastic buckling, with regard to proportioning for full development of compressive strength under longitudinal thrust, and adequate reinforcement against combined transverse thrust and moment.

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Bridge and slab model analysis

Results of an experimental analysis of a small aluminum model of a skewed-slab rigid-frame bridge were presented by D. H. Pletta and Dan Frederick, head and professor, respectively, Applied Mechanics Department, Virginia Polytechnic Institute, Blacksburg, Va., in "Model Analysis of a Skewed Rigid Frame Bridge and Slab." The authors indicated that there has been little experimental verification of design assumptions used in skewed, rigid-frame bridges and this led to the present series of model tests. The program thus far has included tests on an aluminum bridge model, some small reinforced concrete beams and cylinders, and a skewed reinforced concrete slab. Plans are to also include a reinforced concrete skewed-slab, rigid-frame bridge model before the program is completed. Research was undertaken not only to determine the behavior of such structures but, also, to see whether practical results could be obtained from small reinforced concrete models.

No attempt was made to compare test results with analytical analysis, although data for the aluminum model gave a detailed account of stresses and deflections at critical points. Comparison of results for the reinforced concrete models led the authors to conclude that the laws of model analysis are followed quite faithfully within the elastic range, if suitable fabrication techniques are employed. It appears that physical properties of the concrete model will have to be obtained from model studies scaled down proportionately, they went on; however, over-all results are most encouraging and indicate that tsets can be made on models of entire structures, rather than only on their component parts, in small laboratories with a minimum of equipment.

Atom blast

Two movies were shown on the effects of atom blast on structures and occupants by Charles S. Whitney, Ammann and Whitney, New York, N. Y. These showed that design considerations of the future will have to be modified if blast-resistant structures are specified. It was also seen that concrete was a highly desirable material for blast-resistant structures due to its structural action, proved in resisting earthquake forces, and fire resistance.

Awards announced at annual luncheon

President Henry L. Kennedy, on behalf of the Board of Direction, presented awards at the annual Awards Luncheon, Wednesday, February 24, to several individuals who had performed outstanding service in the fields of research, construction, and other ACI endeavors during the past year. J. H. A. Crockett, Alden M. Klein, Phil M. Ferguson, J. Neils Thompson, and David Watstein received ACI awards.

Construction Practice Awardees

Alden M. Klein, assistant manager, New York district, Robert W. Hunt Co., New York, N. Y., and J. H. A. Crockett, civil and structural engineer, London, England, received the ACI Construction Practice Award for their paper, "Design and Construction of a Fully Vibration-Controlled Forging Hammer Foundation," which appeared in the January, 1953, ACI JOURNAL.

The Construction Practice Award was established in 1944 by ACI to recognize the man on the job for his resourcefulness in translating design into the completed structure.

Noteworthy Research

Phil M. Ferguson and J. Neils Thompson received the Institute's Wason Medal for "noteworthy research," reported in the paper, "Diagonal Tension in T-Beams Without Stirrups," in the March, 1953, ACI JOURNAL. Both are associated with the University of Texas, Austin, Texas, as professor and chairman of the Civil Engineering Department, and as head of the Materials Laboratories of the Civil Engineering Department, respectively; in addition Professor Thompson is director of the University's Balcones Research Center.

Most Meritorious Paper

David Watstein, assistant chief, Structural Engineering Section, National Bureau of Standards, Washington, D. C., was the choice for the Wason Medal for "the most meritorious paper" of the volume year, "Effect of Straining Rate on the Compressive Strength and Elastic Properties of Concrete," which appeared in the April, 1953, ACI JOURNAL.

The Wason Awards, established in 1917 by the late Leonard C. Wason, ACI past president, consist of a bronze medal and certificate to each awardee.

Raymond E. Davis elected to honorary membership

President Henry L. Kennedy at the Awards Luncheon announced the election to ACI honorary membership of Raymond E. Davis, consulting engineer and director emeritus, Engineering Materials Laboratory, and formerly professor of civil engineering, University of California, Berkeley, Calif.

Professor Davis is a past president of the Institute, served 17 years continuously on its Board of Direction, and has been on several technical and administrative committees. Author of numerous papers on concrete, he received the ACI Wason Medal for "the most meritorious paper" of 1931, "Flow of Concrete under the Action of Sustained Loads," the same award in 1934 for his work on the paper "Cement Investigations for Boulder Dam with the Results up to the Age of One Year," and in 1948 the ACI Construction Practice Award for a paper of "outstanding merit on concrete construction practice" concerned with "Restoration of Barker Dam." In addition, he was awarded the Institute's Turner Medal in 1952 for "noteworthy achievements" in the concrete industry.

Professor Davis has been active in the concrete field in many capacities as a teacher, consulting engineer, and member of numerous

boards and committees concerned with concrete problems. Many outstanding contributions to the knowledge of concrete have been made by Professor Davis, particularly in the fields of mass concrete, pozzolanic materials, and special cements. In addition, he is the author of several text books on a number of civil engineering subjects, as well as numerous technical articles published in the proceedings of various professional engineering societies.

Graduating from the University of Maine, he taught at the University of Illinois and the University of Nebraska before joining the faculty of the University of California where he remained until retirement.

Courtesy Concrete

ACI President Henry L. Kennedy, left, presents certificate of Honorary Membership to Raymond E. Davis

Certificates presented

Retiring members of the Board of Direction were then given certificates in recognition of their services. Recipients were Frank H. Jackson, formerly principal engineer of tests, Bureau of Public Roads, Washington, D. C.; I. E. Morris of I. E. Morris and Associates, Consulting Engineers, Atlanta, Ga.; and Walter H. Price, head, Engineering Laboratories, U. S. Bureau of Reclamation, Denver, Colo.

Charles H. Scholer heads American Concrete Institute

Charles H. Scholer, head, Department of Applied Mechanics, Kansas State College, Manhattan, Kan., was elected president of the American Concrete Institute for 1954 when results of member balloting were announced Wednesday, February 24, at the Awards Luncheon.

A member of ACI since 1924, Professor Scholer serves on its Committee 115, Research, and Committee 215, Fatigue of Concrete. Administratively, he has been a member of the Institute Board of Direction and vice-president of the Institute.

Professor Scholer's ACI JOURNAL papers include "Studying the Durability of Concrete," and "Consistent Inconsistencies in the Consistency of Concrete." In addition he has co-authored "Effect of Various Coarse Aggregates Upon the Cement-Aggregate Reaction," and "Use of Chicago Fly Ash in Reducing Cement-Aggregate Reaction," with the latter paper earning the Wason Research Medal for Professor Scholer in 1952.

After graduating from Kansas State College, Professor Scholer worked on many engineering assignments including: surveying for the U. S. General Land Office in New Mexico; surveying, maintenance of way and realignment problems for the Atchison, Topeka, and Santa Fe Railroad; assistant

Henry L. Kennedy, retiring ACI president, congratulates Charles H. Scholer on his election to that post for 1954

engineer in charge of surveys, preparation of plans, and supervision of construction of roads, pavements, and bridges for the Extension Division of Kansas State College; assistant bridge engineer in charge of design and supervision of construction of highway bridges for the Kansas State Highway Commission; and professor and head, Department of Applied Mechanics, Kansas State College since 1919 except for a leave of absence to take charge of investigational work in New York and Pennsylvania for the Portland Cement Assn. in 1939 and 1940.

In addition to ACI, Professor Scholer is a member of ASCE, ASTM, NSPE, ASEE, Kansas Engineering Society, the Highway Research Board, Sigma Xi, and Phi Kappa Phi.

Other officers

Other officers announced were Frank Kerekes, assistant dean, Division of Engineering, Iowa State College, Ames, Iowa, for a two-year term as vice-president of the Institute. Elected to three-year terms as directors were Phil M. Ferguson, chairman, Department of Civil Engineering, University of Texas, Austin, Texas; Joseph F. Jelley, Director of Construction, Department of Defense, Washington, D. C.; H. C. Ross, assistant director of research, Hydro-Electric Power Commission of Ontario, Toronto, Ont., Canada; and George W. Washa, professor, Department of Mechanics, University of Wisconsin, Madison, Wis. Charles S. Whitney, partner, Ammann and Whitney, New York, N. Y., and Milwaukee, Wis., elected for a two-year term as vice-president in 1953, continues in that post.

The five members elected to the nominating committee were Charles W. Allen, research engineer, Ohio Highway Department, Columbus, Ohio; Walter H. Price, head, Engineering Laboratories, U. S. Bureau of Reclamation, Denver, Colo.; Carl A. Menzel, consultant on technical concrete problems, Portland Cement Assn., Chicago, Ill.; W. C. Hanna, chief chemist and chemical engineer, California Portland Cement Co., Colton, Calif.; and H. K. Cook, chief, Concrete Research Division, Waterways Experiment Station, Vicksburg, Miss. The remaining three members of the nominating committee are past presidents Harry F. Thomson, A. T. Goldbeck, and Henry L. Kennedy.

President Kennedy emphasizes ACI's expanding services to concrete industry

The Awards Luncheon closed with retiring President Kennedy reviewing the year's activities and introducing new fields of endeavor for the Institute. He emphasized that through an extension of ACI's services and contributions to the industry, the Institute's future growth was assured. (See p. 617 of this month's JOURNAL for complete address.)

In his detailed observations, President Kennedy mentioned that during his trip to Europe, he had 18 conferences and personally met with more than 100 professional engineers and ACI members. It was indeed gratifying to learn the high esteem in which ACI is held in Europe, he said, and added that closer cooperation between ACI and foreign members is worthy of careful consideration.

The relatively new concept of regional meetings was also discussed by President Kennedy, and he held out as examples of what could be done in this field, Boston, Mass., in 1951, and Houston, Texas, in 1953. He felt that it might be possible to have smaller local meetings, probably one-night stands, in many of the smaller cities of about 100,000 population, drawing from a comparatively small area. As the number of local group meetings increased, President Kennedy foresaw eventual formation of ACI chapters which would organize their own meetings, with some assistance, of course, from Institute headquarters.

President Kennedy emphasized that ACI must be brought to the members—especially those who cannot attend annual conventions and local and regional meetings are an important step in that direction.

Production of prestressed concrete units

Mass production of prestressed concrete units that will meet or beat competition of other building materials in the open market is not a simple procedure easily mastered by either engineer or manufacturer, pointed out Orley O. Phillips, president, Phillips, Carter, Osborn, Inc., Denver, Colo., in his talk "Practical Aspects of Plant Produced Prestressed Concrete," presented at the afternoon precast and prestressed concrete session, Wednesday, February 24. The session, under the chairmanship of R. F. Blanks, was held concurrently with one on materials and properties.

By recounting the history of the development of the plant of Prestressed Concrete of Colorado, Inc., in Denver, he impressed upon the audience the importance of careful and thoughtful planning, and, above all, the necessity for close coordination of engineering planning, design, and details with the manufacture, handling, and erection.

Mr. Phillips believed that the pre-tensioning method was the most adaptable to mass production of prestressed concrete members for spans up to about 40 ft. For spans exceeding that, he felt that members could best be fabricated by post-tensioning.

Versatility and speed of production are of primary importance, he indicated—versatility to allow the manufacture of members of various cross section, width, and length, and speed to effect economy of production.

With these objectives in mind, he said, the casting beds used at the plant are 300 ft long and 10 ft wide, with intermediate end anchorages spaced at 20-ft intervals. The tensioning equipment has a 300-ton capacity which can tension up to sixty $\frac{5}{16}$-in. or forty $\frac{3}{8}$-in. strands in one operation.

Mr. Phillips reported that due to the dry mix being used (seldom exceeding 1-in. slump), a concrete block plant type of mixer has been found more satisfactory than the drum type.

One of the most important factors contributing to the speed and economy of production in this type of plant, he pointed out, is the form construction. It must be simple, rigidly constructed, and easily cleaned for re-use.

To meet competition and still realize a profit, he said, the manufacturer must cast the concrete, cure it, and remove the finished product from the forms in the shortest time possible. He said that the Denver operation gets a high early strength concrete by using a dry mix and steam curing. Using only standard Type I portland cement, a minimum compressive strength of 6000 psi is attained in 24 hr. This, coupled with efficient operation, allows the casting of new members on each bed each day.

"Portable" precast concrete hangar

An effective illustration of what can be done in building up a large structure from

Looking ahead to 1955

With the successful completion of the 1954 convention in Denver, ACI's Technical Activities Committee is already looking toward the 1955 meeting in Milwaukee and planning the program.

All those who have in mind offering papers for presentation at the 51st annual meeting should write to Institute headquarters no later than July 1, furnishing a synopsis which should make clear the intended scope of the paper and indicate features that, in the opinion of the author, will justify its inclusion in the program. Contributors should be prepared to have first drafts of manuscripts in the hands of the Technical Activities Committee for appraisal and acceptance by Sept. 15, 1954, and final manuscripts by Jan. 1, 1955.

From the replies received and suggestions from other sources, TAC will select the papers to make up each convention session. Write Institute headquarters about that contribution *you* believe merits a place on the program.

small precast concrete elements was the description of a 130-ft precast clear-span hangar, 160 ft long, recently completed for the Royal Canadian Air Force.

Otto Safir, consulting engineer, Vancouver, B. C., Canada, in "130-Ft Span Hangar in Precast Concrete," (Mar. 1954 JOURNAL, p. 525) said that an unusual requirement for the concrete structure was that the whole of the superstructure could be disassembled and re-erected at a different location to meet changing military needs. In addition, the structure is capable of being erected in northerly areas which permit outside building operations during only a short season.

Maximum weight of the precast members was kept below 12 tons so that standard truck cranes could be used for erection. The arch ribs were approximately 60 ft long (over-all span of three-hinged arches was 110 ft), 10 in. wide throughout, varying in depth from 15 to 26 in., and weighed about 6½ tons. Cantilever columns were 12 in. wide and weighed about 7½ tons. "Lean-to" members were 15 in. wide with a maximum depth of 4 ft 10 in. and weighed 11 tons. The precast roof slabs were purposefully kept narrow, generally 18 in., so as to form a curved roof.

Cost of the precast superstructure for the hangar—comprising bents, stiffeners, roof slabs complete with all fittings, and erected in place—was $5 per sq ft of covered area, noted Mr. Safir.

Precast sandwich panels

The same session included a discussion on "Sandwich-Type Precast Concrete Wall Design and Construction," by F. Thomas Collins, consulting engineer, San Gabriel, Calif.

The precast panels consist of two faces of relatively thin, high strength, high density concrete faces bonded to a core of relatively thick low density material. The various types of sandwich materials used in concrete panels includes cellular glass insulation, plastic, foam concrete, compressed and treated wood fibers in cement, and lightweight concrete using vermiculite, perlite, pumice, and expanded slag and shale aggregates.

While most of the precast sandwich panels cast to date in the United States have been factory fabricated in relatively small panels, Mr. Collins felt that the real field for precast concrete wall panel construction lies with the larger panels cast at the site and tilted up into position by crane. For the job-cast type of large tilt-up sandwich panel, Mr. Collins believed that the most economical and satisfactory filler material is lightweight concrete.

In comparing such a wall with that of regular concrete and common brick of the same insulation (U factor of 0.22 Btu per hr per sq ft per deg F), Mr. Collins illustrated the advantage of sandwich construction. To achieve a U factor of 0.22, a regular concrete wall would have to be 35 in. thick; common brick, 15 in.; and a sandwich concrete panel using vermiculite concrete as the filler, 6 in.

He then described various types of concrete sandwich wall construction now being used.

The "open-face" sandwich wall consists of panels with just two layers of material, a hard outer layer and an interior soft insulation layer. A typical wall would have 2 in. of regular concrete on the outside and 6 in. of lightweight concrete on the interior, which is usually plastered after installation.

A housing project at Great Lakes Naval Training Station, Chicago, Ill., used a 2½-in. layer of mesh-reinforced concrete on the outside, 1½ in. of Foamglas, and an inner layer of 4-in. mesh-reinforced concrete to achieve the sandwich effect.

Another panel, used as cladding the steel frame of industrial buildings, was composed of two outer layers of 1¾ in. mesh-reinforced concrete. The center insulation was a 1½ in. lightweight precast slab of chemically mineralized wood chips.

The panel used on Columbia Cellulose Co., Ltd.'s pulp mill in British Columbia consisted of a 2-in. layer of cellular glass insulation and two mesh-reinforced slabs of 3000-psi concrete, tied together with channel-shaped strips of expanded metal.

One of the few true tilt-up sandwich wall panels, Mr. Collins believed, is one recently developed in Sweden. This panel is composed of 2-in. outer shells of regular dense concrete with 4-in. of lightweight expanded shale concrete between. Mr. Collins claimed that by precasting such panels at the site and tilting them up into position, costs would be from one-half to two-thirds those for smaller

sandwich panels using expensive insulative material. Swedish builders, said Mr. Collins, have found that for buildings with ordinary inside humidity, there seems to be no need for a vapor barrier, provided good dense concrete is used in the inside and outside layers.

Mr. Collins believed that the ideal precast concrete sandwich panel is one that incorporates prestressing in the outer shells. This would not be feasible for panels smaller than 10 x 10 ft, he said. However, it would be economical and feasible for the three-story tilt-up panels that are possible today, he emphasized. In southern California, he noted, 20 ft wide and 30 ft high tilt-up panels are not uncommon; several buildings have used 35 ft high panels.

Prestressed concrete design

"Rapid Design of Continuous Prestressed Members," by E. I. Fiesenheiser, professor and director, Civil Engineering Department, Illinois Institute of Technology, Chicago, Ill., presented an analysis of advantages of prestressing combined with continuity. (See p. 669 of this issue for a complete report.) In some cases, Professor Fiesenheiser said, this combination may lead to more economical construction because (1) prestressing saves material since the entire cross section of a concrete member is in compression, and (2) continuity reduces flexural stresses since the end portions of members carry a share of the bending moment, thus reducing critical positive bending moments.

For rapid design of such members, Professor Fiesenheiser introduced fixed-end moment formulas for various conditions of prestressing. Line of thrust and kern boundary concepts were advocated for use in design, and Professor Fiesenheiser concluded with an illustrative example of a three-span continuous beam structure using these concepts.

Fatigue tests

P. W. Abeles, consulting engineer, London, England, described "Static and Fatigue Tests of Partially Prestressed Concrete Members." He explained that in partially prestressed members tensile stresses are permitted in the concrete under working load, whereas, in fully prestressed members they are not.

Continued on p. 29

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Continued from p. 27

Many tests were carried out on the behavior of partially prestressed concrete under static and fatigue conditions, he said, and permanent freedom from cracking can be expected in spite of the occurrence of limited, though not inconsiderable, tensile stresses under working load.

Dr. Abeles then described static and failure tests carried out in England and Belgium and presented his conclusions regarding partially prestressed members and acceptance tests.

He noted that even if the cooperation between wires and concrete is gradually destroyed and the approaching failure is clearly noticeable by large permanent deflection and wide cracks, the structure is capable of withstanding numerous loadings without failure (*e.g.*, 124,000), although one wire after the other may fracture. Also, he said, even after apparent fatigue failure, a prestressed structure of the type in question may be capable of withstanding still a higher static failure load than that corresponding to apparent fatigue failure.

Where the wire is not embedded in the concrete the cooperation is interrupted, he warned, and conditions quite different from those with bonded wire apply, causing an early fracture of the wire. Consequently, in constructions in which the wires are not bonded a much lower stress ought to be considered for the steel in the ultimate strength, *i.e.*, only the fatigue strength of the wire, which is approximately two-thirds of the static strength.

Dr. Abeles concluded by adding that all conclusions relating to fatigue tests were based on a continuous, repetitious loading. In practical use the conditions are quite different, except perhaps for railroad bridges and special constructions such as turbine foundations, he said.

Void spacing in design of air-entrained mixes

The session on materials and properties, under the chairmanship of Walter H. Price, was held concurrently with the design session, Wednesday afternoon, February 24, and produced several concepts new to the concrete industry.

T. C. Powers, manager, Basic Research, Portland Cement Assn., Chicago, Ill., presented a new approach to the problem of air entrainment in concrete in the paper "Void Spacing as a Basis for Producing Air-Entrained Concrete."

Mr. Powers presented data and analyses showing the relations between the resistance of concrete to frost action and various factors which can be measured directly or computed by approximate equations. He described methods by which it is possible to design a concrete in which the paste has a predetermined resistance to frost action.

Although the methods described were not applicable for use by untrained persons, they seemed sufficiently simple for them to be applied by operators of large ready-mixed concrete plants and by technicians on large construction projects.

Basic studies show, said Mr. Powers, that the function of entrained air is to protect the paste and that the effectiveness depends on the distance from void to void in the paste. Freezing and thawing tests have shown different mixes to have nearly equal frost resistance when the spacing factor is near 0.01 in. The amount of air required for a given spacing factor is directly proportional to the paste content and is greater the smaller the specific surface of the air voids, Mr. Powers pointed out.

The void system is made up of relatively coarse natural voids and entrained bubbles. Characteristics of natural voids vary with aggregate grading, consistency, and other mix characteristics. He went on to point out that with a given amount of air-entraining agent in the mixing water, the amount of entrained bubbles is smaller the greater the quantity of cement or other fine solids in the water.

Mr. Powers believed that complicating the production of air-entrained concrete by

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trying to maintain a fixed total air content under all conditions is not technically justified. He believed that the next step in refining the production of air-entrained concrete might be the adoption of a void-spacing factor as the basis for specifying and controlling air-entrained concrete.

He then outlined a procedure for designing a fixed spacing factor. The amount of air required to produce a given spacing factor, he said, depends on two independent variables: (1) paste content and (2) specific surface of the voids. Examples were given to show how the formulas applied to typical concrete mixes.

Drying shrinkage of concrete block

A tentative theory to explain drying shrinkage of concrete block was presented by George L. Kalousek, Research Division, Owens-Illinois Glass Co., Toledo, Ohio, in the paper "Fundamental Factors in the Drying Shrinkage of Concrete Block."

Shrinkage of concrete block dried to a stable condition successively at humidities of 85, 70, 50, and 25 percent relative humidity (R.H.) was not always related to moisture loss, he reported. In one series of tests, block underwent slight expansion for a time while losing moisture at 70 percent R.H. Sand and gravel block dried at 25 percent R.H. showed no expansion during rehumidification at 50 and 70 percent R.H., although up to 17 percent of the total moisture content was re-adsorbed.

Measurements of apparent surface areas by water vapor and nitrogen adsorption suggested a clue as to the mechanism by which water caused volume changes in concrete block, said Mr. Kalousek. Approximately twice as much water as nitrogen, expressed in terms of surface areas, was adsorbed by the monocalcium silicate hydrate of the tobermorite series, and also by autoclaved and normally cured block. Xonotlite, also a hydrous monocalcium silicate, which, on the other hand, undergoes comparatively small drying shrinkage, showed nearly the same surface area for both adsorbates. This and other considerations were interpreted by Mr. Kalousek as indicating that the water producing drying shrinkage may be accommodated in the atomic structure and was designated as "inter-layer" water.

The amount of this excess water, he said, was about 0.7 times as large for autoclaved units as for normally cured units. Since the autoclaved block showed a shrinkage about 0.6 times as large as that shown by the normally cured ones, Mr. Kalousek suggested that the amount of shrinkage may be proportional to the amount of the "inter-layer" water. Volume changes with adsorption and desorption of water, at least at moderate to low humidities, could be caused by the change in size of the unit cell of the structure of the cementitious phase.

The manner in which the capillary phenomenon may contribute to volume change was also considered. Mr. Kalousek said that the capillary-tension force is probably operative only at high humidities.

Water content of concrete

In the paper "Method for Estimating Water Content of Concrete at the Time of Hardening," James S. Blackman, associate professor of engineering mechanics, University of Nebraska, Lincoln, Neb., presented a rather ingenious idea, and examples and discussion indicated its applicability. (See Mar. 1954 JOURNAL, p. 533.)

Tests and investigations of existing structures frequently present the necessity for determining the amount of materials originally used in the concrete. The construction record traditionally shows the amount of cement and aggregate, but much less frequently the amount of water used. There is also the possibility that extra water was added to the concrete sometime before final placement.

Professor Blackman has come up with a possible solution of this problem and presented a method where the original water content at the time of hardening can be determined for most concretes with reasonable accuracy.

The water content of a concrete at the time of hardening is estimated by determining the total water content of a sample of the hardened concrete after "saturation" by 24-hr immersion, then drying the sample for 2 hr at 1100 F. This method will reveal within reasonable limits the water content of the concrete at the time when the concrete became nonplastic through the incidence of setting. Professor Blackman pointed out

that the method will not account for mixing water lost by bleeding, evaporation, or absorption by subgrades while the concrete was still plastic. He also mentioned that age and exposure conditions of the concrete specimens do not appear to affect test results.

Admixtures

W. T. Moran, chairman of ACI Committee 212, gave a preview of a forthcoming report on admixtures. The committee has classified admixtures into 11 groups: (1) accelerators, (2) retarders, (3) air-entraining agents, (4) gas-forming agents, (5) cementitious materials, (6) pozzolans, (7) alkali-aggregate expansion inhibitors, (8) dampproofing and permeability reducing agents, (9) workability agents, (10) grouting agents, and (11) miscellaneous. He discussed briefly some of the factors which might indicate the usefulness of admixtures of each group and the important effects which may be ordinarily expected from the use of such materials. It is expected that the full committee report will be published in the ACI JOURNAL in a future issue.

Resistance of concrete to scaling

The importance of the "Effect of Age of Concrete on Its Resistance to Scaling Caused by Using Calcium Chloride for Ice Removal," was presented by W. C. Hansen, manager, Research Laboratories, Universal Atlas Cement Co., Buffington, Ind. (See Jan. 1954 JOURNAL, p. 341.)

Tests were made in the field to determine the effect of age of concrete, at the time of the first application of de-icing salt, on the resistance to frost and salt action. Slab specimens, 36 x 36 in., were provided with dikes which permitted the freezing of approximately $\frac{3}{8}$ in. of water on their surfaces. Specimens were made with Types I and IA cements and a blend of the two cements, which yielded concretes having air contents of approximately 1.5, 3.0, and 5.0 percent. Ice was removed by applications of flake calcium chloride whenever the $\frac{3}{8}$ in. of water was frozen solid. A total of 55 cycles of freezing and thawing were obtained in the one winter.

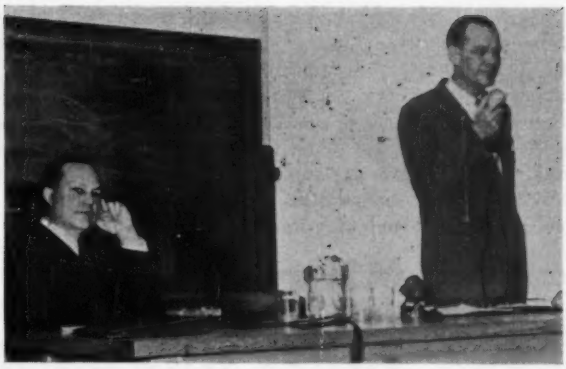
Except for the specimens which were 117 and 91 days, respectively, at the first freeze, he said, those made with concrete containing approximately 1.5 percent air were completely scaled in from 5 to 15 cycles of freezing and thawing. Complete scaling was obtained in less than 55 cycles of freezing and thawing with the concrete containing approximately 3 percent air only on specimens which were 29 days old or less at the time of the first freeze, and with concrete containing approximately 5 percent air only on specimens which were 8 days old or less at the first freeze.

Annual research session held at USBR

Research techniques and preliminary results were presented in a series of papers at the annual open session of ACI Committee 115, Research, Thursday morning, February 25, at the Bureau of Reclamation Laboratories, Denver Federal Center, Denver, Colo. Stephen J. Chamberlin, chairman of Committee 115 and professor of theoretical and applied mechanics, Iowa State College, Ames, Iowa, served as session chairman. The program included papers on fatigue tests of prestressed concrete beams, shear strength of concrete frame members without shear reinforcement, near blast impact tests of reinforced concrete beams, early strength of concrete, volume change and stress-strain characteristics of concrete, effects of alkalies released by pozzolans on alkali-aggregate reaction in mortar, effect of steam curing on concrete durability, jet blast resistant concrete, and use of bonded wire resistance strain gage in measuring transient and residual dimensional changes in concrete during freezing and thawing.

Getting the annual research session off to a good start, Stephen J. Chamberlin (right), chairman of Committee 115, briefs the audience and speakers while George W. Washa, Committee 115 secretary, gets set with the warning light switch in case a speaker talks overtime

Courtesy U. S. Bureau of Reclamation



This convention feature differs from general sessions in that the information is not released for publication, and the "off-the-cuff" reports are regarded as confidential. The organizations concerned have released the following brief summaries for publication in the ACI JOURNAL.

Steam cured concrete

Durability of steam cured concrete was discussed by H. W. Brewer, Bureau of Reclamation, Denver, Colo. Hundreds of feet of concrete pipe are installed each year on Bureau of Reclamation projects. Steam curing of this pipe has varied, depending primarily upon the producer's plant. Tests were made on 768, 6 x 12-in.; 1343, 3 x 6-in.; 36, 6 x 6-in. cylinders; and 384, 3 x 3 x 15-in. prisms to determine the effect of three steam temperatures, four steam periods, two delay periods, and two cement contents on various properties of concrete. Petrographic examination showed that longer steam periods and higher steam temperatures caused more complete hydration, but accelerated freezing and thawing tests showed decreased durability for concrete steam cured at temperatures above 130 F. Compressive strength was also lower at later ages when the steam temperature was above 130 F.

Volume change

Volume change of concrete reported by L. E. Copeland, Portland Cement Assn., Chicago, Ill., dealt principally with the peculiar response of hardened cement paste to variations in temperature. The fundamental cause of the pecularities was discussed in the light of what is known about the thermodynamics of adsorption. Brief reference was made to the connection between the thermodynamics of adsorption and stress-strain characteristics.

Pozzolans and alkali-aggregate reaction

Release of alkalies by pozzolans and its effect on alkali-aggregate reaction was the topic of R. C. Mielenz, head, Petrographic Laboratory, USBR, Denver, Colo. The mode of combination of alkalies in pozzolans is changed by reaction with hydrating portland cement. Some of the alkalies are released from the newly formed combinations when the mortar is crushed and then leached by a large excess of water. However, he said, the alkalies released by pozzolans apparently do not participate in alkali-aggregate reaction in the confines of mortar, at least to ages of one year. In the presence of Pyrex aggregate, sodium present in high concentration (such as in hydrating high-soda cement) and potassium in both high and low concentration enter progressively into combinations which resist leaching.

Early strength of concrete

Strength characteristics of concrete at 12 hr was presented by T. G. Clendenning, Hydro-Electric Power Commission of Ontario, Toronto, Ont., Canada. Adoption of a 24-hr cycle for the re-use of forms for placing concrete lining in large tunnels and the consequent form removal within 12 hr resulted in a detailed study of the strength development of various mixes during this period. Cements used include blends of Type I with fly ash, slag, and natural cement. Cement content was generally 6½ bags

(American) per cu yd but ranged from 5 to 9 bags per cu yd. Curing temperatures of 60, 75, and 90 F were provided as well as simulated adiabatic conditions. Early strength performance of cements in concrete, he noted, was found to be not necessarily related to strength at later ages, and the effect of curing temperature over-shadowed that of cement content. Results were also shown on the effects of calcium chloride, high early strength cement, and aluminous cement. The 12-hr compressive strength range for Type I cements in the 6½ bag mix was from less than 100 to around 1500 psi. The extreme range in 12-hr strength for all mixes was from less than 50 to around 4000 psi.

Jet blast resistant concrete

Techniques in determining jet-blast resistant concretes were explained by P. H. Petersen, U. S. Naval Civil Engineering Research and Evaluation Laboratory, Port Hueneme, Calif. Research was undertaken to evaluate resistance of portland cement concretes to the heat blast of jet engines. An effort was made to correlate behavior of concretes subjected to small scale laboratory tests with behavior when exposed to the jet engine. Laboratory tests, described by Mr. Petersen, included sudden heat exposure, slow heat soak, and an abrasion test. The effect on compressive and flexural strength was noted; sonic determinations were used as a criterion. Further tests are to be conducted, concluded Mr. Petersen.

Shear strength

Shear strength of concrete frame members without shear reinforcement by I. M. Viest, Department of Theoretical and Applied Mechanics, University of Illinois, Urbana, Ill., discussed tests being conducted at the University of Illinois to determine the shear strength of reinforced concrete members subjected to a combination of bending, shear, and axial force. Two types of specimens were employed: knee-frames consisting of two legs joined at a 90-deg angle, and T-frames consisting of a beam and a column stub located at midspan of the beam. All specimens were reinforced with high grade deformed bars in tension only. Variables included were: percentage of longitudinal reinforcement, strength of concrete, and the length of shear span.

Prestressed concrete beams

Fatigue studies on prestressed concrete beams were reported by G. M. Nordby, University of Colorado, Boulder, Colo. A number of bonded prestressed concrete beams were subjected to a repeated application of design load for from one to ten

Research projects compiled by Committee 115

In keeping with the assignment of Committee 115 of reviewing and correlating research in plain and reinforced concrete, research sessions are presented at annual conventions, correspondence is carried out among committee members, and an annual compilation of research projects underway at various laboratories is issued.

The annual compilation for 1954 is divided into three parts. The first gives the names of all educational institutions that are carrying out concrete research and lists the projects that they are working on. The second part provides similar information for noneducational organizations. In the third part the projects are classified under subject headings. This year, 76 organizations from all parts of the United States and from several foreign countries reported to Committee 115, and included universities, highway departments, federal departments, cement companies, industrial laboratories, commercial laboratories, and various associations. The reporting organizations listed 525 different projects under way, which cover all phases of research in the fields of aggregates, admixtures, cements, and plain and reinforced concrete. For those who did not secure a copy of the compilation at the Denver convention, additional copies are available from Institute headquarters in Detroit.

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Near blast impact tests

Identical impulsive loads were exerted on two reinforced concrete beams simultaneously by an impact testing machine of novel design, reported F. T. Mavis, head, Civil Engineering Department, Carnegie Institute of Technology, Pittsburgh, Pa. Beams were 5-in. square and reinforced with one #5 bar of either structural-grade steel (yield point = 37,800 psi, and ultimate strength = 60,000 psi) or hard-grade steel (yield point = 75,400 psi and ultimate strength = 130,000 psi). Loads reached their peaks in less than 0.1 sec.

Whenever structural-grade and hard-grade beams were tested pairwise under identical loading impulses, he said, the permanent set of structural-grade beams was never less than the permanent set of hard-grade beams; on the average it was 13 times greater. A hard-grade beam was always more resilient than its structural-grade counterpart under identical impulsive loadings, and it was still serviceable after its structural-grade counterpart failed. The report was illustrated by a motion picture.

In addition to these papers, R. C. Valore, Jr., materials engineer, National Bureau of Standards, Washington, D. C., reported on the use of the bonded-wire resistance strain gage in freezing and thawing research.

Social functions

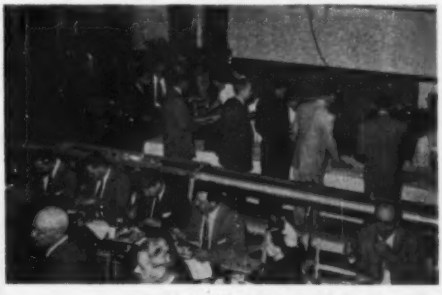
ACI's highly successful 50th annual convention included not only outstanding technical sessions but also an extensive social program which included the 50th Anniversary Dinner, a dinner dance, a barbecue luncheon, inspection trips, and ladies functions.

Socially, things got under way Monday evening, February 22, with the Anniversary Dinner commemorating 50 years of ACI. Cal Snyder, secretary, Denver Chamber of Commerce, welcomed ACI and congratulated the Institute on its 50th anniversary. The major address of the evening was presented by Rear Admiral Joseph F. Jelley, Director of Construction, United States Department of Defense, on the subject of "Builders Abroad."

The next major event was the dinner dance held Wednesday evening, February 24, for ACI members and their wives.

Thursday, February 25, was spent at the Bureau of Reclamation Laboratories, Denver Federal Center, where a buffalo barbecue luncheon was followed by a tour of USBR's laboratories. The huge 5,000,000-lb testing machine used in USBR research was demonstrated.

Inspection trips on Friday, February 26, the last day of the convention, were to Climax Molybdenum Co. Mine, Climax Colo., where the company has developed a method of underground mining in which concrete



Buffalo barbecue luncheon at the Bureau of Reclamation Laboratories was a special feature arranged by the ACI Denver convention committee

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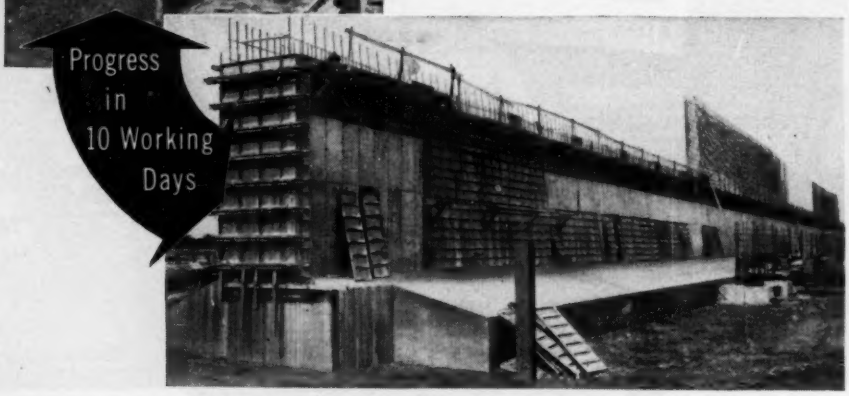

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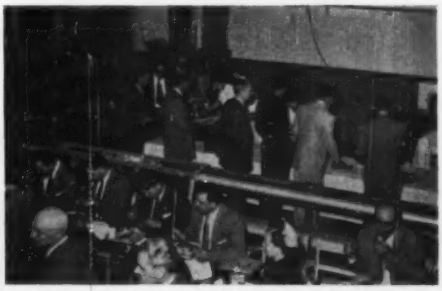


Buffalo barbecue luncheon at the Bureau of Reclamation Laboratories was a special feature arranged by the ACI Denver convention committee

NEW TESTS SHOW

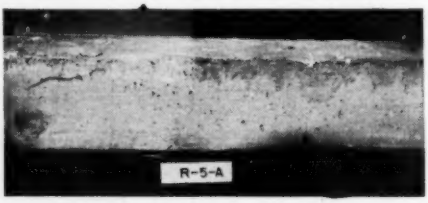
How Concrete Beams React to "Near-Blast" Loads

Recent tests made at a leading American engineering school clearly demonstrate the superiority of hard grade steel reinforcing bars when reinforced concrete beams are subjected to laboratory-created near-blast loads.

Using a specially designed dynamic loading machine, two concrete beams were subjected to equal, simultaneous loads which attained their peaks in less than 1/10 of a second. The beams were identical except that one was reinforced with structural grade and the other with hard grade steel.

These photographs dramatically illustrate typical tests results.

This beam was reinforced with structural grade steel (yield point = 37800 psi). Permanent set after test = 1/29 of span.



This beam was reinforced with hard grade steel (yield point = 75400 psi). Permanent set after test = 1/800 of span.

In fifteen of these near-blast paired tests, the ratio of "permanent sets" varied from 28 for the most severe test to 4 for the least severe. The permanent set of the structural grade reinforced beams averaged 13 times that of the hard grade beams.

After the tests, all of the beams reinforced with hard grade steel were capable of supporting loads. In only three cases was this true of the structural grade beams (and those were the ones subjected to the least severe dynamic loadings.)

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Courtesy U. S. Bureau of Reclamation

One of the features of the tour through the Bureau of Reclamation Laboratories was a demonstration cylinder test in the mammoth 5,000,000-lb testing machine. Here the crowd waits for the "show to begin." Inset: Here's what they saw

plays an important part; Denver's Reservoir No. 22 Dam, South Boulder Creek, Colo., which is under construction—aggregate processing, materials handling, and concrete placing equipment were inspected; Berthoud Pass scenic trip; Ideal Cement Co.'s research center at Boettcher, Colo.; and projects in the Denver area which included concrete construction projects, prestressed concrete structures, and a prestressing plant.

For the ladies many events were specially planned by the Denver ladies committee. Included were luncheon at the world-famous Broadmoor Hotel and tea at the lush and colorful Wolhurst Saddle Club. The Broadmoor is at the foot of Pike's Peak at Colorado Springs, 70 miles south of Denver. Wolhurst formerly was the home of a United States Senator and now is one of Denver's exclusive clubs. In addition, there were luncheons, coffee hours, and teas. One of the teas featured a talk, "Colorful Characters of Colorado," by Miss Caroline Bancroft, author, lecturer, and historian.

Equipment displays

The equipment exhibit was another outstanding feature at ACI's successful 50th annual convention. Held in the Empire room of the Shirley-Savoy Hotel, it was well-attended due largely to the well-planned displays and courteous company representatives.

Each exhibit had available informative material such as catalogs, specifications, and technical literature. Over 35 organizations were represented and included the following.

American Steel & Wire Division, United States Steel Co., Cleveland, Ohio—Illustrations of uses of high strength steel wire and strands in prestressed structures and a model showing prestressing steel and end anchorages.

Autolene Lubricants Co., Denver, Colo.—The Protex air meter and Protex air-entraining agent as a means of obtaining durable concrete. In addition, a 46-page booklet, "Facts on Modern Placement of Concrete Through Air Entrainment," was distributed.

Baldwin-Lima-Hamilton Corp., Philadelphia, Pa.—Testing instruments such as spring testers, SR-4 fluid pressure cells, Type "U-1," SR-4 load cells, and the company's line of compression and tension testing machines were explained through literature and in addition a full-size "console" and "testing head" unit of a testing machine were displayed.

By-Chemical Products Co., San Francisco, Calif.—Thompson's Water Seal for the protection of building materials was demonstrated.

Centennial Engineering Co. — Architectural renderings of various projects were displayed.

Cen-Vi-Ro Manufacturing Co., Nampa, Idaho—Circular and elliptical pipe producing machinery which combines centrifugal force, vibration, and pressure compaction in the pipe-making process. Full size pipe were exhibited.

Colorado Builders' Supply Co., Denver, Colo.—Services of Cobusco include estimating, detailing and fabrication of steel, and building materials in the Rocky Mountain area.

Dart Manufacturing and Sales Co., Denver, Colo.—Electric and gas high-frequency vibrators.

Denform Co., Denver, Colo.—Capital forms used with Sonotubes for forming columns.

Felker Manufacturing Co., Torrance, Calif.—Concrete and masonry cutting machines featuring the Di-Met segmented diamond abrasive wheel. Use is in pavement joints or slab cutting, and concrete masonry.

Freyssinet Co., Inc., New York, N. Y.—Freyssinet units for prestressed concrete construction. Anchorage and jacking units were described by displays and a booklet "Freyssinet Prestressing Units."

Gar-Bro Manufacturing Co., Los Angeles, Calif.—Manufacturer of concrete placing and materials handling equipment. A booklet, "Manual with Check List for Handling and Placing Concrete Efficiently," and literature describing the company's equipment were distributed.

Gates and Sons, Inc.—Rod-type ties for forming were featured and use was illustrated.

Granco Steel Products Co., Granite City, Ill.—Cofar, a combined form and reinforcement for concrete slabs, which is deep-corrugated high-strength galvanized steel with transverse wires welded to it at each corrugation. Various models displayed the use of this product for floors.

Hunt Process Co., Los Angeles, Calif.—Manufacturers of striping machines, spray equipment for precise road marking, and membrane compounds. A model of canal lining operation was shown.

Instant Moisture Control Division, Pre-Mix Concrete Co., Denver, Colo.—An instrument was exhibited which is used for instant determination of moisture content in fine aggregate at batching or handling plants.

Kelley Machine Division, Wiesner-Rapp Co., Inc., Buffalo, N. Y.—Power floats and trowels for compacting and floating through rapid impact from hammers as they strike on a rotating disc; finishing is accomplished with the company's five-blade power trowel.

Long Construction Co., Skyhook Division, Kansas City, Mo.—Models featured the Youtz-Slick lift-slab method of building construction and a full-scale jack was mounted on short column. A pamphlet, "Kansas City Building Slabs Lifted by Bootstraps," was available.

Maginniss Power Tool Co., Mansfield, Ohio—Hi-Lectric portable gas or electrically driven generators and Magic Head concrete vibrators. Generator is designed for use with the vibrator for greater efficiency.

Master Builders Co., Cleveland, Ohio—Products used for integral treatment of

Random shots taken in Golden Anniversary Convention exhibit hall

concrete, concrete floors, mortar, masonry surfaces, and grouting.

Preload Construction Corp., New York, N. Y.—Working model of the Preload-Crom beam winder. A paper, "Why Prestressed Concrete in the Refinery?" distributed by Preload representatives indicated uses of prestressed concrete for refinery tanks; other publications were also available.

Prestressed Concrete of Colorado, Inc., Denver, Colo.—Descriptions of successful applications of prestressing to roofs, beams and girders, and bridge decks were given. Model of long-line plant prestressing bed was displayed.

Prestressing, Inc., San Antonio, Texas—The "PI" methods of prestressing concrete and a cut-away beam section with jack connected were illustrated.

Pumice Inc., Idaho Falls, Idaho—Uses of this lightweight volcanic glass foam as aggregate for concrete and mortars, as well as for insulation material were presented. "The Story of Idaho Pumice" describing the cellular glassy lava material was distributed.

Quick-Way Clamp Co., Denver, Colo.—Shore clamps designed to save material and labor, as well as requiring only a low initial investment. A model illustrated use of the clamps.

Richmond Screw Anchor Co., Brooklyn, N. Y.—Models of various form assembly and anchorage devices.

John A. Roebling's Sons Corp., Trenton, N. J.—Tensioning materials for prestressed concrete including high strength steel wire strands, steel wire for cables, and anchor fittings. Model demonstrated the company's end-anchorage system.

Sika Chemical Corp., Passaic, N. J.—Compounds for concrete which include mortar, coating, and sealing materials. A model of the dispenser used with Plastiment, the company's product for densifying concrete, was also displayed.

Sonoco Products Co., Construction Products Division, Hartsville, S. C.—Laminated fiber tubes for concrete floors, roofs, walls, and bridge deck slabs; fiber concrete column forms designed for use with steel capital forms; and laminated fiber ducts for slab-on-ground perimeter heating.

Superior Concrete Accessories, Inc., New York, N. Y.—Various concrete anchorage and accessory equipment were available for inspection.

Symons Clamp & Manufacturing Co., Chicago, Ill.—Forming system, safety shores, and column clamps. A catalog, "Symons Concrete Forming Equipment," was distributed.

Techkote Co., Inc., Inglewood, Calif.—Techkote White air meter, Sealtex concrete curing compounds, and spray and application equipment for concrete curing compounds.

Universal Form Clamp Co., Chicago, Ill.—Uni-Form panel system for concrete forming. Models and a booklet, "Uni-Form Panels—The Modern Way to Form Concrete," described the system.

U. S. Bureau of Reclamation, Denver, Colo.—Large-scale relief map of Bureau projects, core samples from existing structures, and an illustration of USBR's 5,000,000-lb testing machine.

Viber Co., Burbank, Calif.—Vibration equipment and successful uses were described. Equipment included gas engine driven vibrators and Ferguson-Viber full depth internal slab vibrators.

Water Seals Inc., Chicago, Ill.—Company's line of water stops were shown, and a booklet describing the "Labyrinth Waterstop" was distributed.

Western Waterproofing Co., St. Louis, Mo.—Engineering and contracting firm dealing with concrete restoration, protection, and building cleaning. A booklet, "Water Damage Control" presented results of concrete restoration projects. Nozzles used by the company for shotcreting were displayed.

Denver convention committee

R. F. Blanks, chairman of the local committee, and his able assistants are to be congratulated for the large turnout and their excellent work on con-

vention arrangements. Unlimited effort and widespread advertising and promotion brought almost 800 ACI members and friends to the highly-successful Denver convention.

The executive committee was composed of R. F. Blanks, vice-president and general manager, Great Western Aggregates, Inc., Denver, Colo., chairman; E. W. Thorson, Portland Cement Assn., Denver, Colo., vice-chairman; Orley Phillips, Phillips, Carter, Osborn, Inc., Denver, Colo., treasurer, and in addition, in charge of finance and exhibits; W. H. Price, Bureau of Reclamation, Denver, Colo., secretary, and coordinator of the technical program.

Other committee members included S. H. Poe, Bureau of Reclamation, publicity; Damon Runyon, consulting engineer, Denver, Colo., reception and registration; R. F. McCune, J. L. Peterson, Inc., Denver, Colo., entertainment; A. G. Hoyl, consulting engineer, Denver, Colo., field trips and transportation; R. W. Morris, printing; L. P. Witte, Bureau of Reclamation, tickets and programs; and E. C. Higginson, Bureau of Reclamation, membership.

The ladies executive committee, which developed the excellent ladies program, included Mrs. W. H. Price, chairman, Mrs. E. W. Thorson, and Mrs. R. F. Blanks. The ladies arrangements committee comprised Mrs. I. S. Rasmusson, reception; Mrs. H. S. Meissner, coffee; Mrs. J. R. Florey, luncheon; Mrs. L. P. Witte, tea; and Mrs. C. R. Wilder, coffee.

Tilt-up classes

F. Thomas Collins of F. Thomas Collins & Associates, consulting engineers, San Gabriel, Calif., announced that day and evening tilt-up classes on precast concrete construction will be held by him in the following cities: Chicago, Ill.; Detroit, Mich.; New York, N. Y.; Philadelphia, Pa.; Boston, Mass.; Seattle, Wash.; and Vancouver, B. C., Canada. The accelerated course in "how to do" tilt-up and precast concrete construction includes history, present practice, patent situation, bond breaking, painting, forms, joints, equipment required, erection and bracing, cranes, estimating costs, construction methods, building requirements, precast prestressed concrete, and a precast two-hinged arch. In addition movies will be shown and reprints distributed at the six meetings which constitute the accelerated course.

NCA announces safety awards

The National Constructors Assn. recently announced awards to seven engineering and construction companies for outstanding safety records in 1953.

The companies receiving the safety awards included: the Chemical Construction Co., New York, N. Y.; M. W. Kellogg Co., New York, N. Y.; Fluor Corp., Ltd., Inc., Los Angeles, Calif.; Ford, Bacon & Davis Construction Corp., Monroe, La.; H. K. Ferguson Co., Cleveland, Ohio; J. F. Pritchard & Co., Kansas City, Mo.; and Rust Engineering Co., Pittsburgh, Pa. Awards are part of a continuing, year-round "safety engineering" program launched by the National Constructors Assn. to reduce both the severity and frequency of accidents in the construction industry.

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Positions and Projects — ACI Members

Mather appointed chairman of TAC

Bryant Mather, chief of the Special Investigations Branch, Concrete Research Division, Waterways Experiment Station, Corps of Engineers, Vicksburg, Miss., has accepted an ACI Board of Direction appointment as chairman of the Technical Activities Committee of the Institute. He has been a member of TAC since 1951. He succeeded Douglas McHenry, director of development, Portland Cement Assn., Chicago, Ill., who will remain a member of TAC.

Precast concrete congress

The First International Congress on Precast Concrete, sponsored by the Chambre Syndicale Des Agglomeresde Ciment, Union Professionnelle Reconnue, will be held during June, 1954, in Brussels, Belgium. A preliminary program of the congress includes the following subjects: concrete pipe, high-quality concrete, artificial concrete stone and concrete sculpture, quality testing, organization of casting yards, lightweight concrete block, shrinkage, air-entraining agents, precast concrete floors, precast concrete housing, heavy concrete, productivity in the concrete industry, shrinkage of cement floor tiles, and high-quality precast paving.

Harper enters private practice

Terrell R. Harper announced recently the opening of offices in Dallas, Texas, for the general practice of architecture and building advisory service.

ASTM Committee 50 years old

Committee D-4 on Road and Paving Materials of the American Society for Testing Materials commemorated its 50th anniversary recently during ASTM Committee Week in Washington, D. C. Committee D-4 was one of the three original technical committees of ASTM, being known as Committee "H", and was first authorized in 1903. The membership of the committee has grown from an original membership of 20 to the present membership of 154, and its scope has expanded in keeping with the expansion in types of road materials and construction introduced during this period.

Scholarships established

Establishment of engineering scholarships, with grants totaling $18,000 open to young men of southern California, has been announced by James T. Holmes, president, and D. Lee Narver, executive vice-president, Holmes and Narver, Inc., Los Angeles, Calif., engineering and construction firm.

The Holmes and Narver Scholarship funds provide a grant of $10,000 for four years at the Massachusetts Institute of Technology and $8,000 for a similar course of study at Stanford University. Mr. Holmes is an alumnus of MIT, while Mr. Narver graduated from Stanford. Applicants for the scholarships must be male residents of southern California, in financial need, and students of civil, mechanical, electrical, chemical, or industrial engineering. Preference will be given to students who intend to work in engineering fields concerned with commercial or industrial plant design and construction.

Paris International Trade Fair's 50th anniversary

The 50th anniversary of the Paris International Trade Fair will be celebrated this year from May 22 through June 7. Established for the exchange of ideas, its exhibits of the latest industrial developments and techniques this year will again spotlight technical advances and examples of production from all fields of trade and business. For additional information contact the French Chamber of Commerce, 630 Fifth Ave., New York 20, N. Y.

Engineers meet in Ohio

The First Annual Conference for Engineers will be sponsored by Ohio State University, Columbus, Ohio, and will be held on campus May 7, 1954. The morning session will open with Charles F. Kettering speaking on "Getting Results from Engineering Research." Individual university engineering and science departments will present current research programs and "open house" sessions in the afternoon.

Lightweight prestressed concrete

Suitability of expanded shale aggregate for use in prestressed concrete construction will be studied at Kansas State College, Manhattan, Kan., by the Department of Theoretical and Applied Mechanics under a research contract signed recently by the Expanded Shale Institute with Kansas State College Engineering Experiment Station.

Research on lightweight aggregate, which has been carried on at Kansas State the past year for the Carter-Waters Corp. of Kansas City, Mo., attracted the attention of the Expanded Shale Institute and led to the grant, reported C. H. Scholer, head, Department of Theoretical and Applied Mechanics at Kansas State, and president of the American Concrete Institute.

Thin-shell concrete conference at MIT

A three-day conference on thin-shell concrete will be held June 21-23 at the Massachusetts Institute of Technology, Cambridge, Mass. The conference will be sponsored jointly by the Departments of Civil Engineering and Architecture at MIT and its objectives will be to survey the present status of thin-shell concrete architecture, design, and construction, and to explore avenues for further development of this construction method in the United States.

The location of the conference is especially appropriate because a large auditorium embodying a thin-shell concrete roof is being built on MIT's campus (Fig. 1).

Included in the program on thin-shell concrete will be sessions devoted to architectural design, structural design, and construction techniques. Papers and discussions will be presented by nearly 20 architects, engineers, and builders, and opportunity for discussion and exchange of ideas will be provided. Full details may be obtained from the Summer Session Office, Room 7-103, MIT, Cambridge 39, Mass.

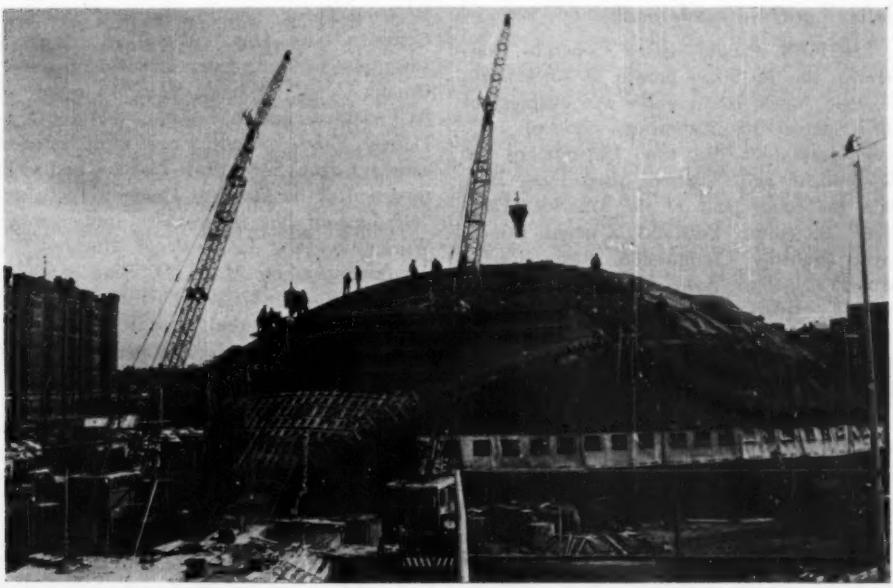

Fig. 1—Placing concrete for MIT's new auditorium which embodies a thin-shell roof. Design by Eero Saarinen & Associates. Structural engineers are Ammann & Whitney; contractor, George A. Fuller Co.

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Better concrete conference

The Fifth Annual Better Concrete Conference was held last month at Iowa State College, Ames, Iowa, under the auspices of the Engineering Extension Service, ISC, and presented by the Department of Theoretical and Applied Mechanics, ISC, with the cooperation of the American Concrete Institute, Portland Cement Assn., Iowa Highway Commission, Iowa Ready-Mixed Concrete Assn., Iowa Engineering Society, American Institute of Architects (Iowa), American Society of Civil Engineers (Iowa), Master Builders of Iowa, and Associated General Contractors of Iowa.

An instructive and well-rounded program on concrete characterized the sessions. The first day of the conference opened with two ACI-PCA films, "Quality Concrete," and "How to Transport, Place, Finish, and Cure Quality Concrete," followed by papers which included the following: "Progress and Availability of Prestress in Iowa," by J. H. Boehmler, Jr., Prestressed Concrete of Iowa, Inc., Iowa Falls, Iowa; "Bridging the Gap Between Theory and Practice in Prestressed Concrete," by Don Pierson, of Humbolt, Iowa, and L. T. Andrus, consulting engineer, Omaha, Neb.; "What's New?" a report of ACI's 50th annual convention held recently in Denver, Colo., presented by Frank Kerekes, assistant dean, Iowa State College, and vice-president of the American Concrete Institute; "Grading of the Aggregate—Influence on Workability and Economy of Mixtures," a demonstration by Marts D. Blue of PCA, Des Moines, Iowa, M. L. Hurst of C. W. Shirey Co., Waterloo, Iowa, and A. R. Livingston, professor, Department of Theoretical and Applied Mechanics, ISC; "Sampling of Concrete and Manipulation of Job Specimens," by Marts D. Blue of PCA, Des Moines, Iowa; "The 'True' Strength of Concrete," by H. J. Gilkey, head, Department of Theoretical and Applied Mechanics, ISC; and an evening address by C. H. Scholer, professor, Kansas State College, Manhattan, Kan., and president of the American Concrete Institute.

The following day also opened with a film,

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Poor and Company elects Walter A. Wecker to board

The board of directors of Poor and Company recently elected Walter A. Wecker of Chicago, Ill., a member of the board. Mr. Wecker has been associated with Marquette Cement Mfg. Co., since 1914 and he has served as president and director of Marquette since 1933. He is also a director of the Portland Cement Assn., and of the Chicago Assn. of Commerce and Industry.

Concrete conference scheduled for Detroit in April

A balanced program on concrete design and construction is to be featured at the Sixth Annual Concrete Conference to be held April 28 and 29 at the University of Detroit, Detroit, Mich. Sponsored jointly by the Portland Cement Assn. and the University of Detroit, the program will include new design techniques, approved specifications, and a demonstration of recommended construction practices.

Floor and pavement design, layout, specifications, and construction will be the featured topics of the first day. M. P. Brokaw, regional highway engineer, PCA, Indianapolis, Ind., will explain the rational design of slabs on ground for heavy loads. A discussion of industrial floors on grade by P. F. Rice, district structural engineer, PCA, Detroit, will complete the Wednesday morning session.

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The two thin shell projects now under construction in the Detroit area will be discussed Thursday afternoon. The Northeast Station filtration building roof design will be explained by Robert W. Stevenson, Detroit Department of Water Supply; construction will be described by Fred Neu, project engineer, Grove, Shepherd, Wilson & Kruge, New York. Features of the thin shell roof for the Edsel Ford Memorial High School, Dearborn, Mich., will be presented by Eberle M. Smith, architect; Alfred Zweig, structural consultant; and Thomas M. Leslie, general field superintendent, O. W. Burke Co., general contractors.

A special evening session of particular interest to those concerned with the design, construction, and economies of industrial buildings will be presented Thursday. Roger H. Corbetta, president, Corbetta Construction Co., Inc., New York, will outline production-line, site precasting used to produce firesafe buildings in competition with ordinary construction. The structures under discussion were originally developed for storage purposes under the direction of Arsham Amirikian, chief designing engineer, Bureau of Yards and Docks, U. S. Navy.

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Better concrete conference

The Fifth Annual Better Concrete Conference was held last month at Iowa State College, Ames, Iowa, under the auspices of the Engineering Extension Service, ISC, and presented by the Department of Theoretical and Applied Mechanics, ISC, with the cooperation of the American Concrete Institute, Portland Cement Assn., Iowa Highway Commission, Iowa Ready-Mixed Concrete Assn., Iowa Engineering Society, American Institute of Architects (Iowa), American Society of Civil Engineers (Iowa), Master Builders of Iowa, and Associated General Contractors of Iowa.

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Continuing Boom Expected in Commercial Building

Commercial construction during 1954 will be among the brightest spots of a generally good construction picture, predicted the February issue of *Construction Markets*, published by the Construction and Civic Development Department, Chamber of Commerce of the United States. At a time when most other types of activity (except highway and school building) are likely to show either only modest increases or declines from the high levels reached in 1953, commercial building is due for another boost of at least 10 percent above last year's boom volume, believed Norman P. Mason, chairman, Construction and Civic Development Department Committee.

Expenditures for office buildings, loft buildings, and warehouses, as a group, can be expected to be about 15 percent greater than in 1953, while outlays for stores, restaurants, and garages are forecast to be at least about 5 percent more. If to these main classes of commercial activity are added hotels, motels, and commercial recreational buildings, the 1954 total will reach the impressive figure of about $2,400,000,000 compared with around $2,200,000,000 in 1953.

This strength in the commercial sector promises to be an important stabilizing force for construction as a whole, points out the report, and in large measure it will offset the expected drop in industrial building.

The current boom is characterized, said *Construction Markets*, by two spectacular features: (1) the lush expansion of office buildings, and (2) a great wave of development of a new type of shopping center.

Office buildings

New York City early took the lead in the number and size of new office buildings erected. After four years of high volume building, New York City still has less than 1 percent vacancy in first-class space, and nearly 6,000,000 additional sq ft of space under construction or in prospect. Pittsburgh, another pioneer in the new office building era, still has plans ahead. Boston, Philadelphia, and Chicago are all busy with new structures, while Baltimore, Washington, Atlanta, Dallas, Houston, Denver, Los Angeles, and San Francisco have additions to the supply of office space planned or under way.

Reasons for the boom, said *Construction Markets*, lie in both the need for expansion and the desire to take advantage of new technology. The typical new office building is a solid block, without court or recess (other than required by law), with a resulting increase in usable space per floor—the principal means by which high cost has been combated.

Shopping centers

The modern shopping center is an outstanding adaptation of a construction type to the motor age, stated the report. Most spectacular feature of this development is the integrated regional shopping center.

For these major centers the typical layout now is focused on one or more important department stores, while disposed about a pedestrian mall, frequently covered and in some cases even heated and air-conditioned, may be found smaller shops. Among the largest of the centers projected for 1954 is the great Skokie Center, northwest of Chicago, which will rival the Northland Center development adjoining Detroit, now completed.

The dispersion of new dwelling construction warrants, believed *Construction Markets*, the building of numerous centers of lesser dimensions, and numerous intermediate variations on the shopping center theme are being built.

Super urban center

Another type of development appearing amid the commercial building boom, said the report, is the integrated central area project, of which Rockefeller Center in New York is the prototype. The Gateway Center project in Pittsburgh, now partially complete, exemplifies the current trend. The Penn Center development in Philadelphia is to be

along the same general lines and work on the first building is expected this year. Boston is now working on preliminary plans for a similar project.

Ancillary construction

The current commercial building boom shows no set pattern in urban development, the report pointed out. Predominantly the trend in new shopping building is toward decentralization, and that of office building toward central concentration; but in neither case is the trend without notable exception.

Central concentration admittedly creates traffic and parking problems. Pittsburgh aims to solve the problem with an interior highway and bridge system that provides arteries leading to and surrounding the central area and an extensive system of parking garages. The Pittsburgh program is typical of the additional construction work that the present boom can and should engender, said the report.

Outlying shopping development also creates problems; and, again, the solution implies a stimulation for ancillary construction. Utility enlargements and extensions are frequently called for; access roads must often be converted to highways, and new traffic ways may be called for.

Another outstanding result of the boom in new commercial building, noted the report, is the incentive it has given to the modernization of existing structures.

Tilt-up precast concrete patent ruled invalid

The Structural Concrete Assn. of Los Angeles, Calif., announced that a recent trial in Los Angeles between O. K. Earl, Jr., and National Panelcrete, Inc., holder of patent No. 2,531,576, found the patent to be void. Of importance to building contractors is that patent No. 2,531,576, commonly known as the McClellan Panelcrete patent on tilt-up precast concrete construction, is believed to have "stiffled" expansion in the precast concrete construction field because of its existence and lack of adjudication. The presiding judge ruled the patent invalid on grounds of "prior art and lack of invention." Expert testimony at the trial was given by F. Thomas Collins, consulting engineer, San Gabriel, Calif., who has long advocated tilt-up precast concrete construction.

LOOKING AHEAD

April 28-May 1, 1954—7th Annual Pacific Southwest Conference, American Society of Civil Engineers, Hotel Senator, Sacramento, Calif.

May 3-8, 1954—30th Annual Meeting, Concrete Reinforcing Steel Institute, Boca Raton Hotel, Boca Raton, Fla.

May 3-14, 1954—British Industries Fair, Olympia and Earls Court, London; Castle Bromwich, Birmingham, England

May 7, 1954—First Annual Conference for Engineers, Ohio State University, Columbus, Ohio

May 23-24, 1954—41st Congress, National Rivers and Harbors Congress, Mayflower Hotel, Washington, D. C.

June 13-18, 1954—57th Annual Meeting and 11th Exhibit of Testing and Scientific Apparatus and Laboratory Supplies, and 9th Technical Photographic Exhibit, American Society for Testing Materials, Sherman and Morrison Hotels, Chicago, Ill.

June 14-18, 1954—62nd Annual Meeting, American Society for Engineering Education, University of Illinois, Urbana, Ill.

June 14-19, 1954—Atlantic City Convention, American Society of Civil Engineers, Chalfonte-Haddon Hall, Atlantic City, N. J.

June 20-27, 1954—International Congress of Concrete Products Manufacturers, Brussels, Belgium

July 11-21, 1954—Sixth Pan American Road Congress, American Road Builders' Assn., Pan American Division, in cooperation with the Venezuelan government and Western Hemisphere engineers, Caracas, Venezuela

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Chicago host to concrete exposition

The Concrete Contractors Assn. of Greater Chicago sponsored a three-day 1954 Midwest Concrete Exposition, March 18-20, at Navy Pier in Chicago. The show drew about 4500 architects, engineers, contractors, and skilled tradesmen from Chicago and surrounding area. Exhibits covered every phase of concrete and concrete construction, including an exhibit by the American Concrete Institute.

In addition to the exhibits, movies on concrete construction were shown, including the new ACI-PCA film, "How to Transport, Place, Finish, and Cure Quality Concrete." There were daily tours through the Portland Cement Assn. laboratory in Skokie.

In his welcoming remarks, Bert Carey, president of the Concrete Contractors Assn., in noting the work of ACI and other organizations, said: "We are keenly aware of the extensive and valuable research—the many thousands of hours of engineering skill—devoted to extending and improving concrete construction, particularly by the American Concrete Institute, Portland Cement Assn., government agencies, and some of our universities."

Errata

The following correction should be made in "Static and Dynamic Elastic Behavior of Reinforced Concrete Beams," ACI JOURNAL, March, 1954.

p. 558—the sixth equation down from the top of the page, immediately preceding Eq. (17), should read:

$$\sum_{n=1}^{n=\infty}\left[\omega_n^2\, z_n(t) + \frac{dz^2}{dt^2}{}_n(t) - w_n(t)\right]$$

$$\int u_n(x)\, u_{n1}(x)\frac{c}{g}dx = 0$$

Errata

In the pictorial series, "Notable Concrete Structures—Old and New," ACI JOURNAL, Feb. 1954, p. 476, the architect for the cafe built for the Builders' Exhibition, Hannover, Germany, should be Gutschow.

Who's Who This Month

Henry L. Kennedy

Retiring ACI President Henry L. Kennedy's address at the general luncheon of the 50th annual convention in Denver, Colo., "Coming of Age," appears on p. 617.

Mr. Kennedy, manager, Cement Division, Dewey and Almy Chemical Co., Cambridge, Mass., is so well known to ACI members that little introduction is necessary.

Norman P. Mason

"Economic Trends Affecting Concrete Construction," p. 625, are described by Norman P. Mason, chairman, Construction and Civic Development Department Committee, Chamber of Commerce of the United States, Washington, D. C.

In 1953 President Eisenhower appointed Mr. Mason to a special committee on housing. He is a past president, Northeastern Retail Lumbermens Assn.; National Retail Lumbermens Assn.; and Massachusetts Retail Lumber Dealers Assn. In addition to his being treasurer of W. P. Proctor Co., operating retail lumber yards in Acton and North Chelmsford, Mass., and Nashua and Milford, N. H., a box factory and kiln drying plant in North Chelmsford, Mass., and a sawmill at Plymouth, N. H., he is a director of South Acton Coal and Lumber Co., Acton, Mass.

Mr. Mason is also president, Board of Governors Building Research Advisory Board Institute, Washington, D. C., and a member of the Executive Committee and the Board, Building Research Advisory Board, National Academy of Sciences, Washington, D. C.

J. F. Jelley

J. F. Jelley, Rear Admiral, CEC, USN, Director of Construction, Department of Defense, Washington, D. C., tells about "Selection of Construction Materials," p. 633.

Following engineering duties at various naval stations, Admiral Jelley was in charge of construction of the Naval Air Station, Alameda, Calif., in 1941, and the Naval Base at Terminal Island, Long Beach, Calif., in 1942. This work involved many types of concrete structures such as hospitals, barracks, prestressed oil tanks, and concrete graving docks. In 1946 Admiral Jelley was named deputy chief of the Bureau of Yards and Docks and in 1949 was named chief. In 1953 he was appointed to his present position.

Admiral Jelley received a BS degree from the U. S. Naval Academy in 1927 and civil engineering and MS in civil engineering degrees from Rensselaer Polytechnic Institute in 1931 and 1932. He is a registered professional engineer in the District of Columbia, a member of ACI and of its Board of Direction, a member of ASCE, Sigma Xi, and of the International Assn. of Navigation Congresses.

W. A. Dexheimer

W. A. Dexheimer, author of "Concrete in Reclamation Construction," p. 637, is Commissioner of Reclamation, U. S. Department of the Interior, Washington, D. C.

During his 27 years as an engineer, Mr. Dexheimer has spent 20 years in western construction for the Bureau of Reclamation —14 of them on projects in the field. Two of these projects involved use of concrete on a scale among the largest in world history —the construction of Hoover and Shasta dams. Following graduation in 1926 from Colorado Agricultural and Mechanical College, Fort Collins, Colo., he joined the Bureau of Reclamation on its Yakima project in Washington in 1928. He was engaged in work on the Boulder Canyon project 1931-36, the Salt River project in Arizona (Bartlett Dam) 1936-38, and the Central Valley project 1938-42. On the Shasta Dam project in California's Central Valley, he directed 300 to 400 engineers.

In 1942 he entered the U. S. Army Corps of Engineers, and served in the China-Burma-India theater until his discharge as a lieutenant colonel in 1946. After a year as an advisor to the Chinese Government at Shanghai, he returned to the Bureau as assistant chief construction engineer, Denver, Colo. Mr. Dexheimer retained this position

until his appointment as commissioner in July, 1953.

S. D. Sturgis, Jr.

"Use of Concrete by the Corps of Engineers," p. 645, is reported by Major General S. D. Sturgis, Jr., Chief of Engineers, Department of the Army, Washington, D. C.

Since his graduation from West Point in 1918 General Sturgis has held every command that it is possible for an engineer officer to have, from platoon leader to the commanding general of a division; from staff officer to commanding general of the American Communications Zone in Europe; and from project engineer to chief of engineers, U. S. Army.

During World War II General Sturgis served in the Southwest Pacific area for three years as chief engineer of the Sixth Army, where he directed the building of air bases, ports, and Army construction in 22 amphibious operations from Australia to Japan. For his outstanding service in New Guinea, New Britain, and Admiralty Islands campaigns, as well as in the invasion of Leyte, the conquest of Luzon, and the occupation of the Japanese islands, he was awarded the Distinguished Service Medal, the Silver Star, the Legion of Merit, and the Bronze Star Medal.

General Sturgis has had broad experience in the civil works of the Corps of Engineers, having served as district engineer in Eastport, Maine, on the Passamaquoddy project; district engineer in Huntington, W. Va., on the Ohio River; district engineer in Vicksburg, Miss., on the Mississippi River; and division engineer of the Missouri River Division, Omaha, Neb., where he was in charge of carrying out the Pick-Sloan plan for the control of floods in the Missouri Basin.

In March, 1953, General Sturgis was appointed chief of engineers, where he commands the world's largest construction agency with a work volume of $4,500,000,000 and has had responsibility for U. S. Army and Air Force military construction around the world as well as the direction of a vast program of public works in flood control, river and harbor improvements, hydroelectric power development, and allied water resource improvements throughout the United States, together with the maintenance of hundreds of such works already completed and serving the people of every region.

J. J. Hammond

"Basic Design Criteria for Concrete Gravity and Arch Dams," p. 657, was written by J. J. Hammond, chief, Dams Branch, Bureau of Reclamation, Denver, Colo.

The work comprises the main parts of a report of a Bureau of Reclamation committee which was made up of 11 top members of the Bureau's design and construction force.

Mr. Hammond received his BS degree in civil engineering at Colorado Agricultural and Mechanical College in 1916. Immediately after graduation, he was employed by the Bureau of Reclamation and spent seven years on projects in Montana and Wyoming. He was then transferred to the chief engineer's offices of USBR, Denver, Colo., in 1923 where he was engaged in work on designs of dams and appurtenant structures.

From 1931 to 1952 Mr. Hammond was in charge of the structural designs of all concrete dams and appurtenant structures. Since that time he has been chief of the Dams Branch which includes the direction and supervision of the designs of all dams proposed and constructed by the Bureau of Reclamation.

E. I. Fiesenheiser

E. I. Fiesenheiser, professor and director, Department of Civil Engineering, Illinois Institute of Technology, Chicago, Ill., informs JOURNAL readers of "Rapid Design of Continuous Prestressed Members," on p. 669.

After spending five years in checking steel and concrete bridge designs for the Bureau of Public Roads, his first position of responsibility was with the Chicago Sanitary District and later with Arthur G. McKee and Co. The latter work included design of dock facilities, power plant, and miscellaneous buildings and bridges for a large blast furnace project in Indiana Harbor.

In 1943 he joined the teaching staff of Illinois Institute of Technology as instructor of civil engineering and since that time has taught many courses in concrete design. He also handles the graduate course in prestressed concrete given at Illinois Institute of Technology.

Active as a consulting engineer, he designed "heavy concrete" shielding for the University of Chicago's large cyclotron and was in charge of design and construction of a paper mill built in Chicago. Professor Fiesenheiser's additional activities include direction of research in the development of heavy concrete for atomic shielding and design of multistory buildings for low-rent housing—research projects carried out at Illinois Institute of Technology. He has been an ACI member since 1946.

John G. Dempsey

"Design of Concrete Mixes for Vacuum Processing," p. 677, is contributed by John G. Dempsey, director, Concrete Division, Sumner Sollitt Co., Chicago, Ill.

Mr. Dempsey is interested in studies of the durability of concrete in service as well as concrete control and inspection and has directed concrete operations and field engineering during construction of Loiza Dam in Trujillo Alto, Puerto Rico, a gravity structure containing about 70,000 cu yd of concrete.

After receiving his technical training at the University of Vermont and Massachusetts Institute of Technology, Mr. Dempsey was employed by state highway departments in Vermont and Missouri on construction work. In 1934 he was employed by the Corps of Engineers on the New England flood control program in the design and construction of concrete flood works. Under the same department, he was also assigned to the construction of Tuscaloosa Lock and Dam at Tuscaloosa, Ala., as concrete and layout inspector. In 1941 he was employed by the F. H. McGraw Co. as concrete engineer on the construction of the U. S. Naval Operating Base at Bermuda.

Prestressed concrete used in refineries

J. S. Bell and D. R. Deveaux, Esso Standard Oil Co., Bayway refinery, Linden, N. J., recently presented the paper "Why Prestressed Concrete in the Refinery?" at the eight annual petroleum mechanical engineering conference of the American Society of Mechanical Engineers, in which it was urged that serious consideration be given to using prestressed concrete instead of steel for storage tanks. Following are some of the author's contentions.

Refiners could cut maintenance costs materially by employing concrete, but have made little use of it because of its tendency to crack under negligible tensile stress.

Early prestressing at 18,000 psi did not apply sufficient compression to eliminate cracks, but today's methods make concrete readily usable for tanks and other uses.

Up to 85 percent of the steel required for a steel tank can be saved through prestressing. Original cost of concrete tanks may be higher than steel in areas where labor costs are high, but steel units generally cost more in the long run. This is because concrete tanks afford such advantages as longer life, easier maintenance, fire resistance, and conservation of stored products.

As an example, Bell and DeVeaux estimated the cost of erecting and operating 151,000-barrel tanks of both types in the Bayway area. They calculated the initial cost of the steel tank at $136,000, or $0.90 a barrel, against $181,000, or $1.20 a barrel for the concrete tank; placed unit life-spans at 30 to 60 years, respectively; assumed a $5000 salvage value for the steel unit, and applied a 4 percent interest rate.

Maintenance for the steel unit was figured at $2500 annually compared with $100 for the concrete one, but the latter item was written off in the belief it was more than offset by hydrocarbon losses caused by maintenance of the steel tank. Final figures were $10,260 per year for the steel tank against $8000 for the concrete, a saving of more than 20 percent. Savings possibilities become even greater when breathing losses are considered, Bell and DeVeaux said.

Size was called a major advantage of prestressed tanks—the only limit is the operation by which prestressed steel is wound around them, and "there is considerable evidence that steel tanks cannot be built larger than 250 ft in diameter without new techniques," the engineers said. Two other advantages of concrete units, fire and shock resistance, were said to permit better use of space in congested areas, since such tanks can be placed closer together.

"It now remains for the refiner to seize upon the opportunity presented by the development of prestressed concrete and make full use of all that it offers to the petroleum industry," they concluded.

New Members

The Board of Direction approved 59 Individual applications, 2 Corporations, 10 Juniors, and 13 Students, making a total of 84 new members. With adjustments for losses due to deaths, resignations, and nonpayment of dues, the total membership for the month of February is 6423.

Individual

ALBORG, WILLIS J., Burbank, Calif. (Fletcher Aviation Corp., Pasadena)

BAILEY, FORREST C. III, Richmond, Va. (Testing Engr., Concrete Building Units Co.)

BASKERVILLE, W. H., Knoxville, Tenn. (Owner, Mgr., Concrete Engrg. Co., Baskerville Bldrs.)

BJORNSTAD, TRYGVE, Seattle, Wash. (Struct. Engr., M. O. Sylliaasen)

BOONE, ORVILLE T., Seattle, Wash. (Struct. Engr., Corps. of Engrs., Anchorage, Alaska)

BOSTEDO, WALTER A., Denver, Colo. (Gen. Supt., Precon Co., Inc.)

BROOKS, FRANK M., Pasadena, Calif. (Pres. & Gen. Mgr., Brooks Products, Inc.)

CAMPBELL, RICHARD W., San Francisco, Calif. (Struct. Engr., Adrian Wilson & Associates)

CHINN, JAMES, Austin, Texas (Asst. Prof. of C. E., Univ. of Texas)

CHIU, Y. L., Taiwan, Formosa (Chief of Touliu Constr. Office)

CHRUDIMSKY, J. G., Springfield, Ore. (Gen. Supt. of Constr., C. J. Montey & Sons, Portland)

CONE, DOUGLAS P., Tampa, Fla. (Road Constr., Tampa Sand & Material Co.)

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Harbord, H. R., San Salvador, El Salvador (Owner, Ready-Mix Cement Business)

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Honor Roll

February 1—February 28, 1954

This marks the beginning of a new year for the Honor Roll, and it gets off to an excellent start with Raymond E. Davis in first place having proposed 10 applicants for membership in ACI. Lewis H. Tuthill follows closely in second place with 7 credits. Herbert K. Cook is third with 3 credits.

This year let's try to have **"every member get a member,"** thereby expanding both ideas and benefits in ACI.

Raymond E. Davis	10
Lewis H. Tuthill	7
Herbert K. Cook	3
Robert F. Adams	2
Grant Bloodgood	2
Elmo C. Higginson	2
L. D. Long	2
C. J. Posey	2
C. H. Scholer	2
J. W. Tinkler	2
Arthur G. Wood	2

ASTM committee week sets new records

A new "high" of 428 meetings by American Society for Testing Materials technical groups was achieved during ASTM committee week in Washington, D. C., last February. New research work was discussed, and many new specifications and tests for materials and numerous revisions were completed. Most of the new and revised standards completed at the meetings are subject to letter ballot in the committees before they are referred to the parent society for action. In general, the new specifications will be considered finally at the ASTM annual meeting in Chicago, Ill., June 13-18, 1954, although some may be approved prior to that meeting through the administrative committee on standards.

ASTM committee action of interest to ACI members included the following.

Committee C-1 on Cement—The report of the activities of the Cement Reference Laboratory was especially significant, as it marked the 25th anniversary of this important function and activity of the committee. The latest report described the activities of the tenth and latest inspection tour of the laboratory which covered a three-year period and included visits to 261 laboratories, in which various apparatus and equipment was checked and calibrated, ranging from balances and glassware to compression testing equipment.

Committee C-3 on Chemical-Resistant Mortars—Acceptance of a proposed tentative method of test for bond strength of chemical-resistant mortars, subject to confirming letter ballot of the committee, represented the completion of much study and research by Committee C-3 in developing this important strength criteria. This method will cover a procedure for determining the bond strength between chemical-resistant mortars and chemical-resistant brick conforming to the existing ASTM "Tentative Specification for Chemical-Resistant Masonry Units (C 279)."

Committee C-7 on Lime—The best means or procedure for determining the bond of lime mortars will receive attention by Committee C-7, and the function of lime with respect to elasticity and flexibility of a mortar will also receive initial consideration by the subcommittee on research. Additional data will be collected through an accelerated program on soundness of lime mortar through the cooperative efforts of the subcommittees on research and on methods of tests.

Committee C-8 on Refractories—Industrial surveys of refractory service conditions in various industries have been an important and valuable part of the accomplishments of this committee, and it was announced that results of a new survey were ready covering the field of hot metal mixers.

Committee C-9 on Concrete and Concrete Aggregates—Greatly expanded use of dry concrete mix materials in packaged form has been recognized by Committee C-9, by the authorization of a new subcommittee which will study and possibly propose specifications as a means of insuring a high-quality product in this field.

As a result of a cooperative test program by the subcommittee on chemical reactions of aggregates in concrete, two recommendations were presented which include a proposed method for measuring potential volume change of cement-aggregate combinations and a revision of the existing chemical method, ASTM Designation C 289, in which the single-end point titration method is substituted for the double-end point calculations.

In the study of durability of concrete, it was reported that efforts will be concentrated on an analysis of supposedly good concrete structures and on construction practice in the over-all study of durability of concrete. Pulse velocity techniques is the current work of the subcommittee on dynamic testing of concrete. New work in the study of aggregate mineralogical characteristics will consist of developing a recommended practice for field investigation of deleterious materials in mineral aggregates.

The "Tentative Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Laboratory (C 192)" was recommended for adoption as standard with certain revisions including more specific descriptions of tamping rods. A new "Tentative Method of Test for Volume Change of Concrete Products" was accepted, subject to committee letter ballot, which is intended for use as a routine standardized procedure on such concrete products as masonry units, concrete pipe, cast stone, or concrete sections.

Committee C-11 on Gypsum—Recognition of the use of aluminum foil in connection with gypsum lath was made, and a revision in the "Specifications for Gypsum Lath (C 37)" will include a requirement and test method for this material, the test method including a determination of thermal properties. Other revisions accepted by the committee include a completely rewritten draft of the "Tentative Specifications for Gypsum Concrete (C 317)" and changes in the sampling requirements of "Specification for Gypsum Plasters (C 28)" and "Specification for Gypsum Partition Tile or Block (C 52)."

Committee C-12 on Mortars for Unit Masonry—Arrangement of designations for the several types of mortar mixes listed in the "Tentative Specification for Mortar for Unit Masonry (C 270)" was given considerable attention to prevent any misinterpretation of their relative quality. A new series of designations were accepted as being somewhat of a "fool-proof" nature in that the designations cannot be construed to have any relation to each other. The new designations of the mortar types, used in connection with mortar proportions by volume in the specification (Table II), are as follows: Type M, formerly Type A-1; Type S, formerly Type A-2; Type N, formerly Type B; Type O, formerly Type C; and Type K, formerly Type D.

Committee C-15 on Manufactured Masonry Units—A specification for a new type of building unit has been accepted by Committee C-15 for submittal to letter ballot. This unit is now referred to as a brick-block clay unit, which because of its volume of voids and cross-sectional design does not fall into either the brick or tile classification. This specification was one of three new projects discussed. A task group was appointed to study and report on the advisability of developing a new specification for low-moisture volume change of concrete masonry units, and this group will also study the need for more specific requirements in the concrete unit specifications, including the possibility of setting up different classes of block based on performance requirements. The third new project authorized was to consider a proposed specification for ceramic power packings by the subcommittee on chemical-resistant units.

Committee C-16 on Thermal Insulating Materials—The effect of moisture and water vapor transmission of insulating materials received considerable attention. A special research program at Pennsylvania State University has shown good progress, especially in the use of the probe method of measurement on dry materials. However, the proper technique for the measurement of wet materials by this method requires more study. A final draft of the proposed method for

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determining water vapor transmission of materials used in building construction was accepted for letter ballot of the committee.

Committee C-19 on Structural Sandwich Constructions—Committee C-19 and its subcommittees met for reports on activities being carried out on the preparation of test procedures for the components of sandwich construction and also for sandwich construction itself. A proposed compression test method for cores, a test for delamination of cores, a possible standard test for core thickness determination, and a discussion of test methods for sandwich construction received attention.

AVP elects new officers

E. L. Miller, vice-president and general manager of American Vitrified Products Co., has been elected president, it was announced recently following that company's board of directors meeting. James G. Robertson, American Vitrified's president since 1933 was named chairman of the board; J. L. Brown, vice-president in charge of sales was named vice-president and general sales manager.

Mr. Miller joined American Vitrified in 1924 in the traffic department followed by work in the sales department, and in 1942 he was named general sales manager. In 1946 Mr. Miller was appointed vice-president and general manager and a director of the company. In addition he serves on committees of the American Society for Testing Materials.

Mode elected vice-president of Ferro

Herbert C. Mode has been elected a vice-president of the Ferro Concrete Construction Co. of Cincinnati, Ohio, a subsidiary of Turner Construction Co. He has been with Turner since 1924.

Steinman honored

At the annual convention banquet of the Ohio Society of Professional Engineers, held recently in Akron, Ohio, Dr. D. B. Steinman, consulting engineer, New York, N. Y., was guest of honor. A scroll was awarded him "in recognition of his international pre-eminence as a bridge designer and in appreciation of his contributions toward the upbuilding of the engineering profession."

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DISCUSSION

Discussion closed January 1, 1954

Sept. Jl. '53

Minimum Standard Requirements for Precast Concrete Floor Units—Committee 711

Concrete for Radiation Shielding—Edwin J. Callan

Absorption by Concrete of X-Rays and Gamma Rays—B. E. Foster

Effect of Sustained Overload on the Strength and Plastic Flow of Reinforced Concrete Beams—G. W. Washa and P. G. Fluck

Economical Design of Prestressed Concrete Beams—David P. Billington

Discussion closed February 1, 1954

Oct. Jl. '53

Proposed Recommended Practice for Selecting Proportions for Concrete—Committee 613

Development of a Cell for the Installation of Electrical Resistance Strain Gages—Herbert E. Worley and Richard C. Meyer

Failure of Concrete under Combined Tensile and Compressive Stresses—Gerald M. Smith

Correlation Between Laboratory Accelerated Freezing and Thawing and Weathering at Treat Island, Maine—Thomas B. Kennedy and Katharine Mather

Membership in the American Concrete Institute

To facilitate prospective members in joining the Institute, membership application forms are provided. Present Members may aid by bringing these forms to the attention of those who may profit from membership advantages. The grades of membership are described overleaf.

All who have an interest in concrete and a desire to improve it through a nonprofit educational service in gathering, correlating, and disseminating information on design, construction, manufacture, use, and maintenance of concrete structures and products are eligible for Institute membership.

There are many opportunities in the Institute for technical committee activity, contributions from your experience in technical papers and the briefer "Letters from Readers" section, and in reviewing technical literature. Thus you can help further ACI's aim "to provide a comradeship in finding the best ways to do concrete work of all kinds and in spreading that knowledge," and at the same time benefit from the experiences of other Members.

(cut here)

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The undersigned hereby applies for_____**membership**
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in the American Concrete Institute. Proposed by_____

For Corporation Membership, ACI representative will be_____

_____ _____
(Date of graduation if Student) (Name, if Corporation)

Signature_____

For our records, please complete both sides of application.

EXCERPTS FROM BYLAWS: ARTICLE I—MEMBERS

Section 1. This Institute shall consist of Members, Corporation Members, Contributing Members, Junior Members, Student Members and Honorary Members interested in furthering the Institute's objects as set forth in its Charter.

Sec. 2. A Member shall be an individual.

A Corporation Member shall be a firm, corporation, society, agency of government or other organization. A Corporation Member shall name one individual as its representative who will enjoy all membership rights and privileges.

A Contributing Member shall be an individual, firm, corporation, society, agency of government or other organization wishing to give larger support to Institute activities through the payment of larger dues. Contributing Members, other than individuals, shall name representatives as do Corporation Members.

A Junior Member shall be a person less than 28 years old.

A Student Member shall be less than 28 years old and a student in residence at a recognized technical or engineering school.

An Honorary Member shall be a person of eminence in the field of the Institute's interest, or one who has performed extraordinarily meritorious service to the Institute.

Sec. 3. All classes of Members except Honorary Members and Student Members, shall be proposed by at least one Member of the Institute and elected by a two-thirds vote of the Board of Direction. An Honorary Member shall be elected by unanimous vote of the Board of Direction. A Student Member shall be proposed by a member of his school's faculty, who need not be a Member of the Institute, and elected by a two-thirds vote of the Board of Direction.

Sec. 4. All Members shall have all rights and privileges of membership as determined by the Board of Direction except that a Junior or Student Member shall not vote nor hold office. The status of a Student Member shall change automatically to that of Junior Member on the first anniversay of his membership succeeding the date on which he ceases to be a student in residence. The status of a Junior Member shall be changed to that of Member on the first anniversary of his membership after he becomes 28 years of age.

Sec. 5. Applications for and resignations from Membership and requests for change of representatives of Corporation or Contributing Memberships shall be presented in writing to the Secretary-Treasurer. Resignations may be accepted only from Members whose dues are not more than 60 days in arrears, except by special action of the Board of Direction.

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Discussion closed March 1, 1954

Nov. Jl. '53

Shearing Strength of Reinforced Concrete Column Footings—Eivind Hognestad

Selection and Design of Prestressed Concrete Beam Sections—T. Y. Lin and A. C. Scordelis

Relation of Shrinkage to Moisture Content in Concrete Block—George L. Kalousek, Richard J. O'Heir, Kenneth L. Zeims, and Edwin L. Saxer

Torsional Rigidity of Rectangular Slabs—Kurt H. Gerstle and Ray W. Clough

Determination of Setting and Hardening Time of High-Alumina Cements by Electrical Resistance Techniques—J. Calleja

Discussion closed April 1, 1954

Dec. Jl. '53

Pier 57 Concreted Through the Winter—M. D. Morris

Factors Influencing the Strength of Concrete as Revealed by a Six-Year Record of Concrete Control—J. J. Waddell

Limit Analysis and Design—William Prager

Floor Aggregates—E. W. Scripture, Jr., S. W. Benedict, and D. E. Bryant

Validity of Certain Assumptions in the Mechanics of Prestressed Concrete—Grover L. Rogers

Discussion closes May 1, 1954

Jan. Jl. '54

Effect of Age of Concrete on Its Resistance to Scaling Caused by Using Calcium Chloride for Ice Removal—W. C. Hansen

Corrugated Box Forms for Concrete Ribbed-Slab Construction—H. C. Pfannkuche

Strap Steel for Prestressed Concrete Structures—K. P. Milbradt

Studies on the Cementitious Phases of Autoclaved Concrete Products Made of Different Raw Materials—George L. Kalousek

Properties of Concrete and Their Influence on Prestress Design—R. E. Davis and G. E. Troxell

Discussion closes June 1, 1954

Feb. Jl. '54

A Story of Progress—Fifty Years of the American Concrete Institute—William A. Maples and Robert E. Wilde

Fifty Years of Development in Building Code Requirements for Reinforced Concrete—Frank Kerekes and Harold B. Reid, Jr.

History and Development of Precast Concrete in the United States—J. L. Peterson

Evolution of Concrete Construction—Roger H. Corbetta

Fifty Years in the Technical Development of Concrete Pipe—Howard F. Peckworth

Discussion closes July 1, 1954

Mar. Jl. '54

130-ft Span Hangar in Precast Concrete—Otto Safir

Method for Estimating Water Content of Concrete at the Time of Hardening—James S. Blackman

Static and Dynamic Elastic Behavior of Reinforced Concrete Beams—Joseph Penzien and Robert J. Hansen

Control of Surging in Concrete Pipe Distribution Systems—C. S. Hale, R. E. Glover, P. W. Terrell, and W. P. Simmons, Jr.

Lightweight Prestressed Concrete—Fred E. Koebel

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Discussion closes August 1, 1954

Apr. Jl. '54

Coming of Age—Henry L. Kennedy

Economic Trends Affecting Concrete Construction—Norman P. Mason

Selection of Construction Materials—J. F. Jelley

Concrete in Reclamation Construction—W. A. Dexheimer

Use of Concrete by the Corps of Engineers—S. D. Sturgis, Jr.

Basic Design Criteria for Concrete Gravity and Arch Dams—J. J. Hammond

Rapid Design of Continuous Prestressed Members—E. I. Fiesenheiser

Design of Concrete Mixes for Vacuum Processing—John G. Dempsey